PAPERS

IN

MECHANICS.

The GOLD MEDAL *of the Society was this Session voted to Mr.* CHRISTOPHER WILSON, *Richard-Street, Commercial Road, London, for a secure Sailing Boat, or Life Boat.*

The following Communications were received from him, and explanatory Engravings are annexed.

A Model and Drawings are preserved in the Society's Repository.

SIR,

HEREWITH you will receive Drawings of a neutral-built self-balanced Boat, with an explanation, which I request you will have the goodness to lay before the Society for the Encouragement of Arts, &c. for their inspection and approbation. I have made the explanation as clear as I can. Its construction will obviate the danger of its being overset by persons crowding on one side, in getting in or out

of the boat; it will facilitate the landing of men on shore or in boarding ships, and will carry a much greater press of sail without danger.

As to the building part, I think that may be easily understood. My boat was made by men that had never before seen a boat built, and I flatter myself the Society will approve of it.

I am, Sir,

Your most obedent humble Servant,

CHRISTOPHER WILSON.

March 10, 1806.

To C. TAYLOR, M. D. SEC.

An Explanation of the Engravings of a neutral-built self-balanced Boat.

By the term neutral is meant, what is neither of the two present modes now in use, i. e. clincher and carver, but both united, viz. clincher in the inside and carver on the outside, which neutralizes both the two into a third; and as every thing has a distinguishing name, I have taken the liberty to present it to the public, under the name of a Neutral Boat.

The two modes of clincher and carver-built have each their separate advantages and disadvantages in regard to each other.

I shall begin with the clincher first. As the sides of the planks are firmly fastened to each other, by lapping over and rivetting, they are much stronger than if the edges only butted, and they have the property of being made tight without caulking, only in the buddings and keel seams,

seams, and are much lighter than carver-built boats, and more adapted for many uses; beside saving the difference between thick and thin plank. But they have their disadvantages also; in the first place, both unfair sides and unfair water lines, which makes them liable to be injured by other bodies they come in contact with, and have the edges of the planks broke so as to make a leak, which would not happen to a smooth-sided boat, neither can the uneven side move so well through the water, on account of its various resistances. They have also this disadvantage, that if damaged, they require the skill of a professional workman to repair them.

The carver built boats have the advantage of having smooth sides and fair water lines, together with having the planks of an equal thickness all over the boat, which makes them less liable to receive injuries when meeting with other bodies, and more adapted to move in the water, by their fair sides and fair water lines. They are also more readily repaired: if a professional boat-builder is not at hand, it can be done by a common shipwright, or any workman that is used to wood work.

But they have also their disadvantages; in the first instance they are under the necessity of being built of plank of a great thickness to stand caulking; at the same time they require larger timbers, which makes them heavy and unfit for many uses, and also a great consumption of timber on account of the thickness of the plank necessary. They are also more subject to leaks from various causes than clincher-built boats.

We will now look to the neutral system, and see if both their advantages are not united, and both the disadvantages got clear of.

Plate 4, Fig. 2, shows the section of the fore part of a boat.

boat. The longitudinal slips are represented lighter-coloured, and placed over the joints where the edges of the planks meet; they must be rivetted on to each adjoining plank, near the edge, in the same manner as clincher-built vessels, with a sufficient quantity of blair, made of tar and flocks, such as is in common use in the North of England, (or any other caulking), between the slips and planks, which will always keep them tight, as long as the boat remains unstaved, or the planks worn through. These slips, each being rivetted to the two adjoining edges of the planks, as shown in Fig. 4, will make the joint as strong as the joint of a common clincher-built boat, and as tight, without the risk of any external damage. Those joints have also this advantage, that the planks will not have their sides bevelled off, but be of an equal thickness from edge to edge, which is not the case in clincher-built vessels, for at the ends they are half bevelled away, so as not to bear clinching. By the neutral system two inches in the breadth of each plank will be saved in the laps, which may be considerable in the conversion of plank. I set little value on the slips, as there is always a sufficiency of waste in cutting the planks to a proper form.

A boat of this construction has all the strength of one clincher-built, and can be made as light or lighter. It is free from the disadvantages of irregular outsides, and from the difficulty of repairing, which in this can be performed by any common workman in wood, as I have found by experience. A boat built this way has a fair and smooth outside, it has all the advantages of a carver-built one, at the same time it is clear of the disadvantages of being loaded with unnecessary wood, which makes the carver-work very heavy, the liability of leaks, and frequent want of caulking. There is one evil which both carver and clincher-built boats have

Mr. C. Wilson's secure Sailing Boat or Life Boat.

Fig: 1.

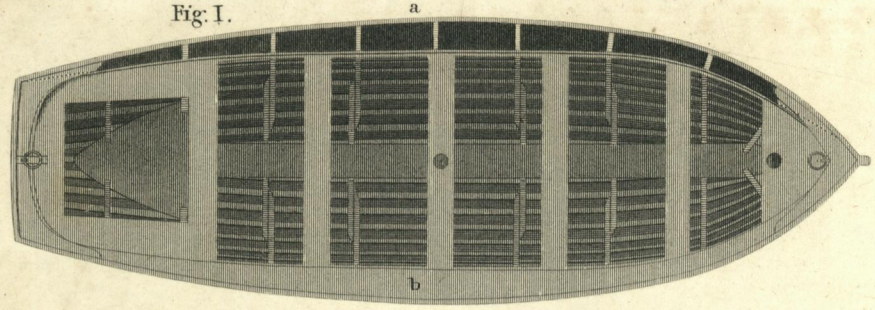


Fig: 2.

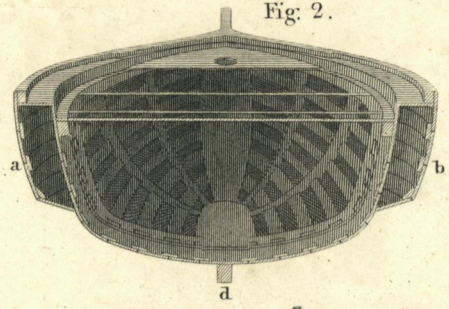


Fig: 3.

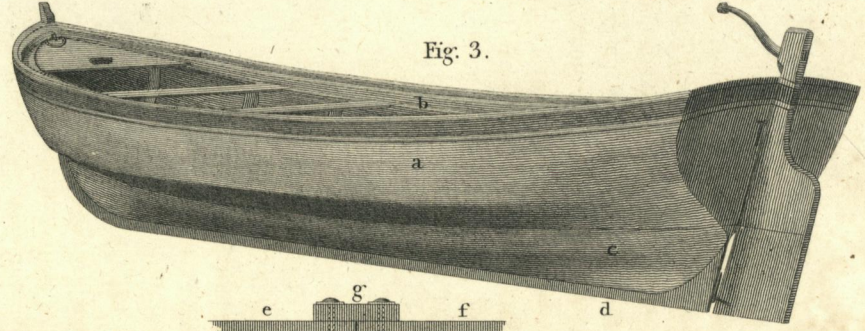
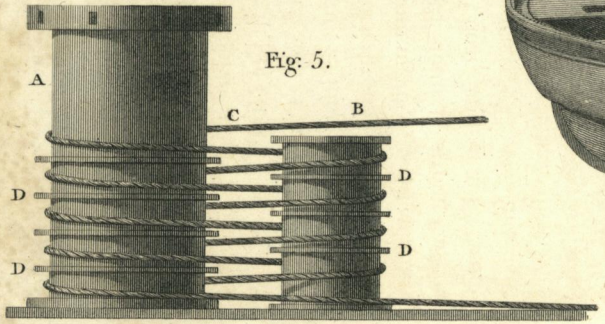


Fig: 4.

Fig: 5.



Mr. J. W. Boswell's improved Capstan.

C. Varley del.

S. Porter sculp.

have in common, that of having keel seams, and a vacancy between the sand or garboard streak, and the upper part of the keel, which soon gets filled with dirt, and remains so, which naturally retains moisture, and speedily rots the wood. In this mode that evil is removed, by having the midship plank bolted on to the keel, wide enough to come over each side of the keel to clinch the slips on, this not only removes the evil, but saves a great deal of trouble in making the rabbets in the keel, and various bevellings in the sand streaks, which must be done by a good workman.

These boats require no larger timbers than common clincher-built boats, as the timbers need no greater notches, but with this difference, that these timbers will catch the slips that are rivetted over the joints of the planks each way, and so the timbers and slips will brace one another, and add an additional strength; but in the clincher-built boats, the timbers catch the laps of the seams only one way, and consequently form no brace whatever.

All I need to explain further on the neutral system is its application. It can be applied to all open boats, of whatever form or use, to all coal and other barges, lighters, or any vessels used in rivers or canals, and also to all large cutters and luggers, which are now clincher-built.

Explanation of Plate 4, *Fig.* 1, 2, 3, 4.

Fig. 1, is a bird's-eye view of the boat, shewing the projecting balance bodies, or hollow sides *a b*, one of which *a*, is left open to show the partitions which are placed opposite to each timber, and are water-tight; by this means if one or more should be broken, the rest would keep the vessel buoyant. These partitions gradually lessen towards each

each end, where the planks unite, so as to make a similar appearance to any other boat when in the water.

Fig. 2, shews the depth and form of the cells or hollows, as they appear in a section of the boat; also the manner in which the slips are placed over the joinings, or seams of the planks.

Fig. 3, is a perspective view of the boat, in which *a b* show the projecting balance bodies, or hollow sides, which would render the boat buoyant if her bottom was staved in. *c*, the lower part or body of the boat, from which the projections commence; *d*, the keel.

Fig. 4, shows the manner in which the planks or timbers of the boat are united; *e f*, are two planks of the boat; *g*, the slip of wood placed over them, and secured to them by the rivets *h h*.

The section (Fig. 2), will best explain the nature and utility of the self-balanced boat. The balance bodies form two separate holds, to put any thing in, such as provision, arms, &c. which are wanted to be kept dry, having locker lids, to open at the top of the different partitions in the holds, as fancy or utility may require; or part of them may be filled with cork shavings, and by that means, if the boat should happen to fill by any accident, she cannot sink.

In the boat I have altered for Government, the balance bodies, (if the interior of the boat was filled with water), would exclude as much water, between the inside of the boat and the outside, as is equal to a body of water of 1ton. 17cwt. 2qrs. which is a great deal more than the weight of men that will go in her, consequently they can run no risk whatever of being drowned, and even if she had a hole through her bottom, she would always keep a sufficient height out of the water either for rowing or sailing.

But the main object is to make her sail and row much faster

faster than other boats, and both on calculation and trial my boat will be found to sail much faster, and with much less danger than other boats.

I now come to the advantage of rowing.—As the balance sides project a foot beyond the resisting part in the water, there is that leverage on the boat (over a common one), and also the same in the length of the loom of the oar, that is in the inside from the gunwale of the boat, which allows the whole of the oar to be lengthened, and by that means it describes a larger circle in the water, and makes a longer pull: the oars for the Government boat I have made, are lengthened from 14 to 18 feet.

The experiment of having two spars fixed at a distance from a boat's gunwale, and the oars to work from them, has often been tried and found to answer, but this has a great advantage over that method.

There is another advantage or property which this boat has, she cannot roll at sea, but always keeps a level position as far as the surface of the sea will allow; she may heel but not roll, as the balances are always ready to catch either way, and the opposite one assists the other by its weight out of water and gravitation; neither can this boat pitch like another, for the balance bodies being out of the water, and the breadth of six feet only in the water, it can only act with a gravity on the water, equal to a boat of the weight of six feet, but as the resistance of the water upwards equal to a boat of eight feet wide.

Or I may make this mechanical simile: Suppose a workman uses a chissel to smooth a surface of wood, by laying too great a stress on the tool it will go too far into the wood for him to force it along in the direction wanted, but put that chissel into a stock like a plane-stock, and set it to the depth required, then the stock will prevent its going too far

far in, and he can work easily though the plane be pressed on ever so hard. A view of the Engraving will elucidate that comparison, as the balance bodies lie parallel with the surface of the water lengthways. The national importance of such boats, I leave to the public to decide. I must here observe, that my plan contains two distinct and separate improvements, viz. my neutral mode of building, and the application of the balance bodies.

The first improvement relates to the *building* of boats, barges, &c. in general. The second is only partial, and applicable to boats of peculiar descriptions or uses; that is, all such as are wanted for dispatch, safety, or pleasure, or occasionally for life-boats: as there can be no question of the self-balanced boats built upon my plan, rowing and sailing faster than other boats, and they may be used to go to sea when others cannot; but the application of the balance bodies is not meant as a general one, as it is not fit for vessels of burthen that are sometimes light, and at others heavy laden, when the difference of the draught of water is considerable.

CHRISTOPHER WILSON.

CERTIFICATE.—We whose names are hereunto subscribed have examined the boat building on Mr. Wilson's plan, (which he calls the neutral plan) and are of opinion that it will be attended with many advantages.

The boats can be built as light as those that are clincher-built, preserving a smooth surface, and will not require caulking; and they can be easily repaired by any carpenter.

The advantage this boat possesses by having air gunwales are obvious, and from the partial trial we have had of

of the boat's sailing which he has altered, we are of opinion that his improvement in the keel and formation of the boat's bottom, will give her greater stability than other boats of the same dimensions, with the properties of sailing well and drawing very little water.

MALCOLM COWAN, R. N.
JAMES NICOLSON, R. N.

London, May 7, 1806.

GENTLEMEN,

PERMIT me to present my thanks and acknowledgments for the truly polite and distinguished manner in which (though a stranger,) you have permitted me to visit your Committee; the Society of which the same is formed I hold in the highest estimation, and have deeply to regret the distance that prevents my offering myself a candidate for a seat amongst you.

The last time I had the honour of attending your Committee, Mr. Wilson's new Life-Boat became the subject of discussion, the operation of which you did me the honour of requesting me to acquaint you of as soon as an opportunity presented itself for a fair trial of her at sea.

About three o'clock in the afternoon of Friday last, the tide being about quarter flood, and the wind at South-west, blowing excessively hard, an object was discovered in the Offing at about two leagues distance, bearing from the piers of Newhaven, W. S. W. which had the appearance of a vessel

vessel water-logged, and with only her foremast standing. This induced Mr. Thomas Tasker (the person whom I appointed master of the boat, and which I have named the *Adeline*,) with seven others, to put to sea, with a view of rendering assistance to the supposed distressed vessel, and although the breakers were tremendous, and the sea without them running very high, the boat under the management of the crew before-mentioned, ranged as coxswain, six setters, and a bowman, went out of the harbour in a very lively stile, and soon came up with the object in pursuit, which proved to be a beacon, or light-house, of a singular construction triangularly built, and clench-board covered in its floating case, with a mast rigged out in the centre of one of the sides, and supposed to have broken a drift from the enemy's coast by the boisterous weather: finding its magnitude too vast for their strength to tow, and the evening approaching, they returned. Numbers of persons were assembled on the piers to witness the action, power, and performance of the boat, who were highly pleased and gratified. I was not present myself, but the next morning one of the crew was sent to me from Newhaven to this place, who stated that the whole of them were so fully satisfied with the safety and superior powers of the boat, that they shall not be afraid to put to sea in any weather when the distresses of their fellow-creatures claim their exertions and assistance. They particularly observed, she, with the six oars manned, pulled extremely light and easy through the water, and that though the breakers they pulled through, and the heavy seas they rode over were awful, she did not ship ten gallons of water the whole trip, neither were the men wet on the seats. We have now at Newhaven one of Mr. Greathead's boats, provided by subscription, but from the difficulty of getting her to sea, and her weight and construction

rendering

rendering it almost impossible to pull her through the broken water, it is very improbable she will ever be used.

My opinion is, that Mr. Wilson's boat will answer. Its cost I conceive will exceed 150*l.* including the building and fitting her out.

I have the honour to subscribe myself with the greatest respect,

Gentlemen,

Your obliged and most
obedient humble Servant,

WILLIAM BALCOMBE LANGRIDGE.

P. S. I should have observed, that the crew pulled her *stern on* at every sea, and that such water as in general fills over the bow of ordinary boats, is received by the fore-part of her flammings, or floor of extended sides, and sent or dispersed side-ways.

Lewes, Sussex, Dec. 25, 1806.

To C. TAYLOR, M. D. SEC.

The GOLD MEDAL *of the Society was this Session voted to* J. WHITLEY BOSWELL, *Esq. of No.* 15, *Clifford's Inn, for his Model of a Capstan, which works without requiring the Messenger or Cable coiled round it to be ever surged.*

The following Communications were received from him, and an explanatory Engraving is annexed

A Model of the Machine is placed in the Society's Repository.

SIR,

I REQUEST you will lay before the Society of Arts, &c. the model of a capstan contrived by me, which works without requiring the messenger or cable coiled round it to be

ever surged, an operation necessary with common capstans, which is always attended with delay, and frequently with danger. Capstans of this kind can be made by a common shipwright, and would not be liable to be put out of order. They also would not occasion any additional friction or wear to the messenger or cable, in which particulars they would be superior to the other contrivance hitherto brought forward for the same purpose; they also would much facilitate the holding on.

The great loss of time and great trouble which always attends applications to the Navy Board, prevent my attempting to bring the matter before the public through that channel, though I have had the most unequivocal approbation of the capstan from the two gentlemen of that board best qualified to judge of it. I mention this, least it might be thought that my not applying there first was from any doubt of the goodness of the invention. If the Society should approve of the capstan, I will draw up a more minute account of it for publication.

I am Sir,
Your very humble Servant,

Hatton Garden, Oct. 29, 1806.

To C. TAYLOR, M. D. SEC. J. W. BOSWELL.

SIR,

I HAVE examined your model of a Capstan, which is calculated to prevent the surging of the messenger when heaving in the cable, it certainly possesses great merit, and the idea to me is quite new.

I am, Sir,
Your humble Servant,
WILLIAM RULE.

Somerset-place, November 19, 1806.

To MR. BOSWELL.

SIR,

SIR,

ACCORDING to your desire, I transcribe the part of the letter from Mr. Peake (Surveyor of the Navy) to me, which relates to the capstan laid before the Society.

Extract of a Letter from Henry Peake, Esq.

"With regard to your ideas on the capstan; I have tried "all I can to find some objection to it, but confess I "hitherto have been foiled, and shall more readily forward "it, if it was only to supersede a plan now creeping into "the service, more expensive, and much worse than one "lately exploded."

As you and the members of the Committee have seen the letter, I imagine further attestation needless relative to it.

I request you will mention, that all friction of the revolutions of the cable (or messenger) in passing each other between the barrels of the capstan, must be effectually prevented by the whole thickness of one of the rings that passes betwixt each crossing. I add this because one of the gentlemen of the Committee wished to be informed on this point.

I am, Sir,
Your very respectful humble Servant,

J. W. BOSWELL.

Hatton Garden, November 26, 1806.

To C. TAYLOR, M. D. SEC.

SIR,

IN obedience to your intimation, that a written explanation of the advantages to be obtained by the use of capstans made according to the model, which I laid before the Society for the Encouragement of Arts, &c. would be acceptable, I send the following, which I hope will make the subject sufficiently clear.

As few but mariners understand the manner in which cables are hawled aboard in large ships, it will probably render the object of my capstan more manifest, to give some account of this operation.—Cables above a certain diameter, are too inflexible to admit of being coiled round a capstan; in ships where cables of such large dimensions are necessary, a smaller cable is employed for this purpose, which is called the *messenger*, the two ends of which are made fast together so as to form an endless rope, which, as the capstan is turned about, revolves round it in unceasing succession, passing on its course to the head of the ship, and again returning to the capstan. To this returning part of the messenger, the great cable is made fast by a number of small ropes, called nippers, placed at regular intervals; these nippers are applied, as the cable enters the hawse hole, and are again removed as it approaches the capstan, after which it is lowered into the cable tier.

The messenger, or any other rope coiled round the capstan, must descend a space at every revolution, equal to the diameter of the rope or cable used; this circumstance brings the coils in a few turns to the bottom of the capstan, when it can no longer be turned round, till the coils are loosened and raised up to its other extremity, after which the motion proceeds as before. This operation of shifting the place of the

the coils of the messenger on the capstan, is called *surging the messenger:* It always causes considerable delay; and when the messenger chances to slip in changing its position, which sometimes happens, no small danger is incurred by those who are employed about the capstan.

The first method that I know of, used to prevent the necessity of surging, was by placing an horizontal roller beneath the messenger, where it first entered on the capstan so supported by a frame, in which it turned on gudgeons, that the messenger in passing over it was compelled to force upwards all the coils above the capstan, as it formed a new coil.

This violent forcing of the coils upwards along the barrel of the capstan, not only adds considerably to the labour in turning the capstan, but from the great friction which the messenger must suffer in the operation, while pressed so hard against the capstan, (as it must be by the weight of the anchor and strain of the men,) could not but cause a very great wear and injury to the messenger, or other cable wound round the capstan; and that this wear must occasion an expense of no small amount, must be manifest on considering the large sums which the smallest cables used for this purpose cost.

The next method applied to prevent surging, was that for which Mr. Plucknet obtained a patent, the specification of which may be seen in the Repertory of Arts, No. 46: In this way a number of upright puppets or lifters, placed round the capstan, were made to rise in succession, as the capstan turned round by a circular inclined plane placed beneath them, over which their lower extremities moved on friction wheels, and these puppets, as they rose, forced upwards the coils of the messenger on the barrel of the capstan. This was a superior method to the first, as the operation of

forcing upwards the coils, was performed more gradually by it; but still the wear of the messenger from the lateral friction in rising against the whelps of the capstan remain undiminished.

The third method used for the same purpose, was that proposed by captain Hamilton. It consisted in giving the capstan a conical shape, with an angle so obtuse, that the strain of the messenger forced the coils to ascend along the sloped sides of the barrel. The roller first mentioned was sometimes used with this capstan, of which a full account is inserted in the Repertory of Arts, vol. 2. The lateral friction, and wear of the messenger against the whelps of the capstan, is equally great in this method as in the others; and it, besides, has the inconvenience of causing the coils to become loose as they ascend; for as the upper part of the barrel is near a third less in diameter than the lower part, the round of the messenger that tightly embraced the lower part, must exceed the circumference of the upper extremity in the same proportion.

In the method of preventing the necessity of surging, which the model I have had the honour of laying before the Society represents, none of the lateral friction of the messenger or cable against the whelps of the capstan, (which all the other methods of effecting the same purpose before-mentioned labour under,) can possibly take place, and of course the wear of the messenger occasioned thereby will be entirely avoided in it, while it performs its purpose more smoothly, equally, and with a less moving power than any of them.

My method of preventing the necessity of surging, consists in the simple addition of a second smaller barrel or capstan of less dimensions to the large one; beside which it is to be placed in a similar manner, and which need not

in

in general exceed the size of an half-barrel cask: The coils of the messenger are to be passed alternately round the large capstan and this small barrel, but with their direction reversed on the different barrels, so that they may cross each other in the interval between the barrels, in order that they may have the more extensive contact with, and better gripe on each barrel. To keep the coils distinct, and prevent their touching each other in passing from one barrel to the other, projecting rings are fastened round each barrel, at a distance from each other equal to about two diameters of the messenger and the thickness of the ring. Those rings should be so fixed on the two barrels, that those on one barrel should be exactly opposite the middle of the intervals between those on the other barrel: and this is the only circumstance which requires any particular attention in the construction of this capstan. The rings should project about as much as the cable or messenger from the barrels, which may be formed with whelps, and in every other respect, not before-mentioned, in the usual manner for capstan barrels, only that I would recommend the whelps to be formed without any inclination inwards at the top, but to stand upright all round, so as to form the body of the capstan in the shape of a polygonal prism, if the intervals between the whelps are filled up, in order that the coils may have equal tension at the top, and at the bottom of the barrels, and that the defect which conical barrels cause in this respect may be avoided.

The small barrel should be furnished with falling palls as well as the large ones; a fixed iron spindle ascending from the deck will be the best for it, as it will take up less room. This spindle may be secured below the deck, so as to bear any strain, as the small barrel need not be much above half the height of the large barrel; the capstan bars can

easily pass over it in heaving round, when it is thought fit to use capstan bars on the same deck with the small barrel. As two turns of the messenger round both barrels will be at least equivalent to three turns round the common capstan, it will hardly ever be necessary to use more than four turns round the two barrels.

The circumstance which prevents the lateral friction of the messenger in my double capstan, is, that in it each coil is kept distinct from the rest, and must pass on to the second barrel, before it can gain the next elevation on the first, by which no one coil can have any influence in raising or depressing another; and what each separate coil descends in a single revolution, it regains as much as is necessary in its passage between the barrels, where in the air, and free from all contact with any part of the apparatus, it attains an higher elevation without a possibility of friction or wear.

I have described my double capstan, as it is to be used in large vessels, where messengers are necessary, from the great size of the cables; but it is obvious that it is equally applicable in smaller vessels, as their cables can be managed with it in the same manner as is directed for the messenger. The same principle may also be easily applied to windlasses, by having a small horizontal barrel placed parallel to the body of the windlass, and having both fitted with rings, in the same way as the capstan already described. The proper place for the small horizontal barrel is forward, just before the windlass, and as much below its level as circumstances will admit; it should be furnished with catch-palls as well as the windlass.

Besides the advantages already stated, my proposed improvement to the capstan has others of considerable utility. Its construction is so very simple, that it is no more liable to derangement or injury than the capstan itself. Its cost can be

be but small, and every part of it can be made by a common ship carpenter, and be repaired by him at sea if damaged by shot. It will take up but little room, only that of an half-barrel cask; and it is of a nature so analogous to that kind of machinery to which sailors are accustomed, that it can be readily understood and managed by them.

In order to render the description of my double capstan more clear, I annex a sketch of it, as fitted up in the manner proposed.

I am, Sir,

Your very respectful humble Servant,

J. WITLEY BOSWELL.

To C. TAYLOR, M. D. SEC.

Reference to the Engraving of Mr. Boswell's improved Capstan, to prevent the necessity of surging. Plate 4, *Fig.* 5.

A Represents the larger or common capstan used on board ships.

B Another capstan of less dimensions, placed in a similar manner.

C The coils of the messenger passing alternately round the large and small capstans, but with their direction reversed on the different barrels, so that they may cross each other in the interval between them.

D D D D Projecting rings round each capstan or barrel, so fixed on the two barrels, that those on one barrel should be exactly opposite the middle of the intervals between those on the other barrel.

TWENTY GUINEAS *were this Session voted to Mr.* GILBERT GILPIN, *of Old Park Iron Works, near Shifnal, for his Machine for raising Coals, or other Articles, from Mines.*

The following Communications were received from him, and an explanatory Engraving is annexed.

A complete Working Model and Drawings are placed in the Society's Repository.

SIR,

THE improvement of the machines in use for raising coal and ore from the mines, has long been a desideratum of the Society for the Encouragement of Arts, Manufactures, and Commerce, and they have repeatedly offered a premium for that purpose.

Those in general use (from the encreased expense of horse labour), are worked by a steam engine, attached to a crank of twenty-one inches radius, wedged on a shaft along with a fly wheel, eleven or twelve feet in diameter, and pinion wheel, of eleven teeth, which latter works in another of sixty-four teeth, on the shaft of which is a plain cylindrical barrel, from four to six feet diameter, and nine or ten feet long; some have barrels formed of frustums of cones, (whose perimeters are in the proportion of about five to four), united at their bases, and of various diameters; the axes of both kinds are placed at right angles with the centre line of the pit, and at each end a rope of six inches in circumference is made fast by a staple, which ropes work (in contrary directions at the same time) over two pulleys, placed in a frame parallel to each other, and at an equal distance from the centre of the pit; to the ends of these ropes the baskets of coal and ore to be raised are hooked.

The simplicity of their general structure is such as, perhaps,

haps, not to admit of any considerable improvement; but the forms of the barrels are very defective.

On putting one of these machines in motion each rope forms a triangle, the lines thereof from the pulley to the first and last coil, and the surface of the barrel, forming its three sides. Upon the cylindrical barrel the load always tends, from gravitation, towards the nearest point of contact with the centre of motion of the barrel, and, in consequence, the ascending rope at first bends around it in receding coils from the subtending side of the angle, diminishing their distances as they approach the nearest point of contact, (where the rope crosses the centres of the pulley and barrel at right angles), thereby leaving a great part of the latter uncovered by the rope, and hence the necessity of such long ones; afterwards coiling hard against itself as it approaches the other side of the triangle, to its great injury in wear.

The barrels formed of frustums of cones, united at their bases, whose perimeters are in the proportion of about five to four, are equally defective, on account of the rope, for the reason before mentioned, binding hard against itself, and even sometimes, (in wet weather, when its rigidity is encreased by absorption of water,) folding at first in receding coils, and afterwards so hard against itself as to force those receding coils to slip suddenly towards the small perimeter of the cone, thereby making a large portion of the rope to descend the pit in an instant, breaking the rope by the sudden jerk, and frequently causing the immediate destruction of the men who may be ascending the pit at the time, or dashing to pieces the basket and its contents.

Besides the unnecessary expence arising from the use of hempen ropes, and the breakage of chains when applied in the common way, the forms of the barrels are quite erroneous

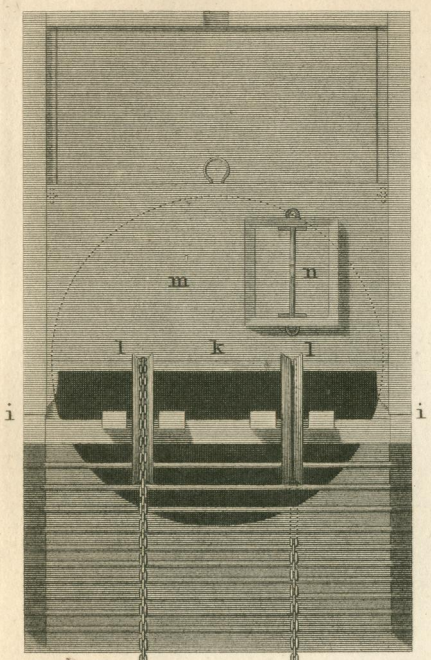
neous in principle. Some are cylindrical; others formed of frustums of cones united at their bases, without any determinate proportion in their perimeters, or regard to the weight of the rope or chain working thereon, both of which are absolutely necessary to acquire a maximum effect.

The convex surface of a frustum of a cone, is = to the convex surface of a cylinder of the same altitude, having its circumference = to half the sum of the perimeters of the frustum: and circumferences of circles being to one another as their diameters, the surface of a barrel formed of two frustums of right cones (united at their bases), each 64 inches diameter at one end, 32 at the other, and 54 long, which is the size we have adopted here, is = to the surface of a plain cylindrical one, 48 inches diameter, and 108 long. Each will therefore bend the same length of cordage in an equal number of revolutions, and so far they are equal to each other; but they vary very considerably in the momenta required to work them.

Let a = the weight of the basket of coal, and b = that of the descending part of the chain; then, on the cylindrical barrel, when the former is hooked to the end of the latter, and eased from the bottom of the pit (the opposite chain being bent on the barrel), $a + b$ = the counterpoise required at 24 inches radius; and when it is wound up to the top (the descending part of the opposite chain hanging down the pit), $a - b$ = the counterpoise required at the same radius.

On the barrel formed of frustums of right cones, when the load is eased from the bottom of the pit, it and the chain are suspended from one of the smaller perimeters (the opposite chain being bent on the barrel), $\frac{a}{2} + \frac{b}{2}$ = the counterpoise required at 32 inches radius; and when it is wound

Mr. Gilpin's Machine for raising Coals, Ore &c.



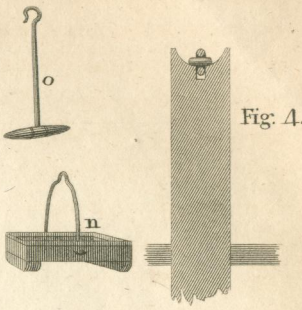


Fig: 4.

Fig: 3.

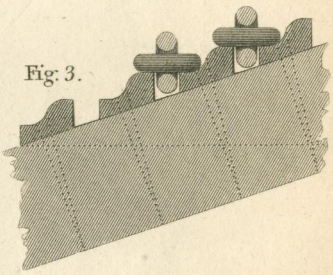
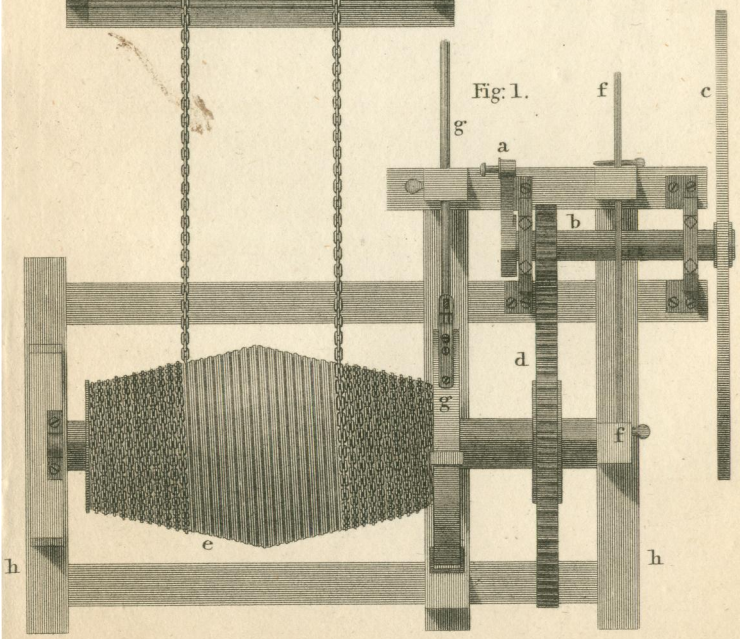


Fig: 1.



wound to the top of the pit, it is suspended from the larger perimeter of one frustum, whilst the descending part of the opposite chain is hanging down the pit from the smaller perimeter of the other, and in that position $a - \frac{b}{2}$ = the counterpoise required at the same radius.

Consequently, by supposing a, the weight of the basket of coal, to be 800lbs. and b, the weight of the descending part of the chain, 400lbs. (these are the weights which we have adopted here), we have the counterpoise required upon the cylindrical barrel, at 24 inches radius, 1200 lbs. when the basket of coals is at the bottom of the pit, and 400 lbs. when it is at the top; but upon the barrel formed of frustums of right cones, the counterpoise required at 32 inches radius is 600lbs. in each position. And as the counterpoise required is in inverse proportion to the length of the radius at which it is applied, we have 24 : 32 :: 600 : 800 lbs. the counterpoise required upon the barrel formed of frustums of right cones, at 24 inches radius. Again, as the descending part of a chain + a basket of coal of double its weight, unbending out of equi-distant grooves from the base of a frustum of a right cone, towards its smaller perimeter, balances in every revolution of the barrel, a chain of equal weight + a basket of coal, of double its weight, bending into equi-distant grooves from the smaller perimeter of a similar frustum towards its base, the counterpoise required must be equal in all parts of the descent.

So that by making the weight of the basket of coal to that of the chain, and the perimeters of the frustums of cones, which form the barrel, to each other, in the proportion of two to one, *a maximum is obtained, by which a barrel of this description requires one-third less momentum, (and consequently one third less expence), to work it than a cylindrical one.*

The

The barrels are made by nailing two to three inch planks upon wooden or iron curves, as in the common way, and afterwards folded, spirally, with wrought iron tire, so as to leave a vacancy of about half an inch between each fold, for the lower part of the ellipses of those links of the chain which work vertically to move in, and keep the coils at an equal distance from each other.

The wrought-iron tire is of two kinds, the one for conical, and the other for cylindrical barrels; the cross section of that for the barrel formed of frustum of cones, is nearly a parallelogram, ($1\frac{1}{4}$ inch by $\frac{5}{8}$ths, out of which the ellipsis is taken, $1\frac{1}{4}$ inch by $\frac{1}{2}$ an inch;) out of the upper part of which about one-fourth of an ellipsis is taken, to form a horizontal bearing for those links of the chain which lie flat upon the tire; the cross section of the latter is a rectangle. Both are rolled into their proper form, and holes of a quarter of an inch diameter punched therein, at a foot from each other, for the purpose of nailing them to the planking of the barrels.

As the method of working chains in grooves has only been in use about three years and a half, it is impossible to give a certain idea in respect to their durability. In all that time not a single link has broke, or the least accident occurred therefrom, though Messrs. T. W. and B. Botfield, have nearly three thousand feet in daily motion at this manufactory. The wear has also been so trifling, that I conceive they will sooner fail from oxydation than attrition: for although the machines for raising coal and ore from the mines are in use twelve hours in the day, the brown oxide of iron formed upon the links by exposure to the atmosphere, is seldom disturbed by the motion of the chain. It is probable, therefore, that in this manner of working, chains will last at least fifteen years, but to be certain we take it at twelve in the

the subjoined comparative statements, which shew that the expence of chains as cordage is only about a twenty-fourth part of that of hempen ropes.

The method of folding wooden barrels with wrought iron tire, does away the necessity of cast iron ones, and may be applied to every wooden barrel now in use at a small expence, as may be seen by the estimate which is subjoined.

There are now at work in the mines of this manufactory, four machines, with wooden barrels folded with wrought iron tire, one cylindrical, and three formed of frustums of cones, raising upwards of eight hundred tons of coal and iron ore per week from pits of about eighty yards deep; and three others are in hand.

I look forward with confidence to the general substitution of chains for hempen ropes at all our mines and manufactories, a matter of importance to the British empire, as it will considerably lessen the consumption of hemp, and render it more abundant for the exigencies of the Navy.

Wishing to give this method of working chains all the publicity in my power, I will obviate all apparent (for there are no real) difficulties which may occur to any person in their application, on his stating them in a letter *post paid* addressed to me here.

I am, Sir,

Your most obedient Servant,

GILBERT GILPIN.

Old Park Iron Works, near Shifnal, 2 Feb. 1807.

To C. Taylor, M. D. Sec.

Expence

Expence of tarred ropes for a machine for raising coal and ore from a pit eighty yards deep, for three years and four months.

	£.	s.	d.
Ten ropes each 110 yards long, 6 inches in circumference, and 5 lbs. per yard, 5500 lbs. at 8*d.* per lb.	183	6	8
Deduct 10 worn out ropes 2750 lbs. at 1*d.* lb.	11	9	2
Net expence of ropes for 3 years and 4 months	£. 171	17	6

Expence of chains for a machine for raising coal and ore from a pit eighty yards deep.

Two chains each 110 yards long, formed of $\frac{3}{8}$ inch iron, 28 links to the yard, and weighing 5 lbs. per yard, 1100 lbs. at 6*d* per lb.	27	10	0
180 yards of wrought iron tire, with the holes punched therein weighing 7lbs. per yard, at 1*s.* 6*d.* per yard	13	10	0
540 Nails for the tire, 27 lbs at 6*d.* per lb.	0	13	6
Workmanship, nailing the tire on the barrel, 180 yards at $2\frac{1}{2}$*d.* per yard	1	17	6
	£. 43	11	0

The above chains and tire have been at work three years and four months, and do not appear to be one-fourth worn.

SIR,

SIR,

THIS is to certify, that Gilbert Gilpin has invented a method of raising coal and ore from the mines by means of chains working in grooves, formed by folding wooden barrels spirally, with wrought iron tire, so as to leave a vacancy between each fold for the lower parts of the circumferences of those links of the chains which work vertically to move in, and thereby cause uniformity and safety in motion; four of which machines we have now at work at our mines at this place, one with a cylindrical barrel, and three formed of frustums of cones, which machines, are (to the best of our knowledge) superior to any hitherto known or in use, and will produce the effect at a much less expence.

(Signed,)

T. W. and B. BOTFIELD.

Old Park Ironworks, 6 March, 1807.

To C. TAYLOR, M. D. SEC.

SIR,

MESSRS. T. W. and B. Botfield inform me, that they sent the certificate in respect to the machine for raising coal and ore from the mines, to you yesterday.

You will please to observe, that of the four machines now in use, two only work with *two chains each,* and they are both formed of frustums of cones; the other two, the one with a cylindrical barrel, and the other a frustum of a cone, have each a chain at one end, and a patent flat rope at the

other. We are induced to adopt the latter plan to do away by *degrees* the prejudices which Miners and Colliers have imbibed against chains, from accidents which they have been witnesses to in the common way of working. Though the causes of similar accidents are entirely done away by the new method of working, some little of the old prejudice remains; a thing not to be wondered at when we consider the uninformed state of this description of men, arising from a life spent in the dark recesses of mines; and, as it were, cut off from the rest of society.

From the uniformity and safety of the new method, their prejudices against chains are, however, rapidly wearing away, and I have no doubt that in a few years they will even be preferred. It is certainly more reasonable to suppose that this will be the case from the superiority which iron holds in point of strength of materials, than that ropes even should have been known, (at least in the mines,) had the new method of working chains been in use prior to the introduction of hemp.

By excusing the liberty which I am now taking, you will oblige,

Sir,
Your obedient Servant,

GILBERT GILPIN.

Old Park Iron Works, March 7, 1807.

To C. TAYLOR, M. D. SEC.

Reference to the Engraving of Mr. Gilbert Gilpin's improved Machine for raising Coal, Ore, &c. *Pl.* 5. fig. 1, 2, 3, 4.

Fig. 1. *a.* A crank to which the connecting rod is fixed to attach the machine to the steam-engine which works it.

b. A

b. A wheel of 18 teeth, wedged upon the same shaft with the crank, and which works into the wheel *d.*

c. A fly wheel 11 feet in diameter, wedged upon the same shaft as the wheel *b.*

d. A wheel of 64 teeth wedged upon the same shaft as the barrel, into which the wheel *b* works.

e. A wooden barrel, formed of two frustums of cones united base to base, and folded spirally with wrought iron tire, which keeps the links of the chains at right angles with each other, and with the grooves in the pulleys.

ff. The reeling-post and its lever, for disengaging the barrel from the steam-engine, when the men are to be let down into the pit by means of the break.

gg. A break wheel, break and lever, for regulating the velocity of the barrel when disengaged from the steam engine, and in the act of lowering the miners into the pit.

hh. The frame on which the machine is erected.

ii. Fig. 2. The pit-frame, for supporting the pulleys.

k. The pit represented by a circle, part of which is shewn open, and part by dotted lines.

ll. Two grooved pulleys, over which the chains, extending a considerable length from the barrel *a* work in parallel lines.

m. The carriage (called a tacking in Shropshire) on which the coal and ore are landed from the chain at the pit head, moving on four small iron wheels.

nn. Baskets on which the coal and ore are raised from the pits.

o. The hook which goes into the staple of the basket to draw it forward when lowering on to the tacking.

After the basket is lowered, the tacking is drawn forward by two girls to the edge of the frame, which is laid level with the ground on its outside, and near to which the coal

and ore are loaded into waggons, and afterwards drawn upon iron rail-ways to the furnaces, forges, &c.

Fig. 3. A section of a part of the barrel and tire, showing the manner the links of the chain lay on it, on a scale of 3 inches to the foot.

Fig. 4. A section of the pulley, with a link of the chain lying in it.

In a large machine the barrel is fixed 24 or 25 yards from the pit, which is a distance of nine feet in the model sent to the Society.

Although the small chain for the model was made in Birmingham, it is remarkably full of twist, and the links in general awry where they join, in some parts as much as half the thickness of the link. It does not, therefore, keep well in the grooves, or, indeed, will it at all without a weight of 5 or 6lbs. attached to the end of it, and the barrel and frame at the proportional distance of about nine feet from each other.

The SILVER MEDAL *of the Society was this Session voted to Mr.* A. STASS, *No.* 18, *Porter-street, Newport Market, for a Machine for closing Boots and Shoes in a standing Posture.*

The following Communication was received from him; an Explanatory Engraving is annexed; and a complete Machine is placed in the Society's Repository.

SIR,

I BEG leave to acquaint you, that I have invented a machine in which a numerous class of working-men are greatly interested, as it preserves their health, and forwards their work

work with more facility than in their present mode; which hath hitherto required them to sit in a cramped and unhealthy posture. This machine is for the use of boot-closers, harness-makers, army accoutrement-makers, leather pipe-makers, &c. to enable them to perform their work in a standing posture. I invented a machine last year for shoemakers, of which I daily see the happy effects to the labouring class of that trade; and the business of boot-closing, &c, being regarded by medical men as equally injurious, it has induced me to invent this machine, the utility of which has been fully proved by my having closed upwards of 250 pairs of boots on it, and by finding it to answer well for that purpose. I have, therefore, offered it to the consideration of the Society, hoping that by their patronage it may be brought into universal use.

I am, Sir,

Your obedient humble Servant,

A. STASS.

April 8, 1807.

To C. TAYLOR, M. D. SEC.

Reference to Mr. A. STASS's *Machine for Boot-closing.*
Pl. VI. *Fig.* 1, 2, 3, 4, 5, 6, 7.

Fig. 1. *a.* The clamp or boot-holder, having a cross joint acting within the block *b*, more plainly shewn in the section of the block at Fig. 3.

c. A strong piece of wood firmly fixed in the table, having three holes or mortises to receive the tenon of the block *b*, and thereby to alter the position of the clamp or boot holder; the sloping one is for sadlers-work, the other two

being one over the other are to raise or lower the work to suit the height of the workman; *d d* the lower arms of the boot-holder; *e e* straps from the pedal *m*, joined to the arms by small hooks, by which means the foot being pressed on the pedal, tightens the work in the boot-holder; *f f* a box or table with a drawer under it.

g. A crossing strap, serving for the pedal strap, to be fastened to when the boot-holder is placed obliquely.

Fig. 2. A side view of the boot-holder and block.

Fig. 3. A section of the joint in the block, one arm of the clamp or boot-closer being mortised through the other.

Fig. 4. A side view of the table with a half round arm *h* (mortised into the post *i*), having a strap *k* reaching down to the pedal to hold the work on; *l* another mortise for the post *i* to turn the work the other end foremost.

Fig. 6. A section of the block *h*.

Fig. 7. A plan of the table, showing the two mortises of the post *i*.

The following Persons have given their Testimony to the Utility of the Machine, viz.

JOHN CLARKE JERVOISE, Esq. Hanover-square.
JOHN HAY, Chandos-street, Boot-maker.
EMANUEL VAUGHAN, 4, Clement's-inn, Boot-maker.
JOSEPH PROUD, 46, Bedford-street, Boot-maker.
JOHN WALKER, 21, Vere-street, Oxford-street.
J. LAURIE, Harness-maker, Oxford-street.
FRANCIS POWELL, Chandos-street, Boot-Maker.

TWENTY GUINEAS *were this Session voted to Mr.* CHARLES LE CAAN, *of Llanelly in Wales, for improved Tram-Plates for Carriages on Rail Roads.*

The following Communication was received from him, and an Engraving is annexed.

Specimens of the Tram-Plates and Drawings are placed in the Society's Repository.

SIR,

I HAVE forwarded to the Society of Arts, &c. a specimen of my new method of laying rails, or tram-plates, on such a plan as has met the entire approbation of those who have seen it, and are acquainted with the principle on which such roads should be formed. Rail roads are daily increasing, from the great advantage they afford to those manufactories connected with mines and minerals, particularly to collieries. They also promote agriculture, by occasioning lime to be procured from places almost inaccessible by any other means, or from whence it could be otherwise brought on moderate terms.

I flatter myself that every improvement on this system will be of national importance. The honour I received last year from the Society of Arts, &c. has stimulated me to submit the present subject to their consideration.

I have also sent a drawing of my method of laying the tram-plates, with an estimate of the saving that will arise to the public, by adopting the said method, with necessary remarks on the principle on which it is founded. The leading rail or tram-plate has neither tenon or mortise over the plug. The stop-plate terminates the specimen, which stop-plate should go in with some degree of tightness when laid for actual use, but in the present case that force is not ne-

cessary, as the wooden blocks by a carriage of upwards of 200 miles, may in some small degree be misplaced. I hope any impediment of that nature will be rectified or allowed for. I wish it to be understood, that a stop-rail is intended to be placed at every 30 yards, at which distance any repairs may be made within ten minutes, which by the present mode frequently occupies more than twice that time, exclusive of disturbing in some measure the line of road. By my method, the plate have a certain degree of play, which is absolutely necessary to avoid that breakage which too frequently takes place when they are fixed with nails and plugs.

The plates which I send have been fixed in stone blocks, and are nearly as rough as when taken from the sand. If I am favoured with any mark of the Society's approbation, I shall hold myself bound to transmit such further communications on this subject as may be required by them, or any person desirous of adopting my plan.

I am, Sir,

Your most obedient Servant,

CHARLES LE CAAN.

Llanelly, Carmarthenshire, May 12, 1806.

To C. TAYLOR, M. D. SEC.

SIR,

I HAVE considered the improvement made by you in the specimen exhibited of a new design of a tram-plate, and am

am of opinion that much advantage may be derived to tram roads, by the adoption of your plan in preventing the temptation of stealing the wrought-iron nails, with which the plates are usually fastened, and by facilitating the operation of laying down new tram roads, and repairing of old ones.

I am, Sir,

Your most humble Servant,

J. VANCOUVER.

Llangennech Park, April 2d. 1806.

To Mr. Le Caan.

SIR,

Several tram-plates on your new method of fixing without either nail or plug have been cast under my immediate inspection, at Stradey furnace. The same may be made with as much ease as any others now in use, and I conceive they will obviate the many impediments that arise from the irregularity of driving the nails. I have no doubt from my observation of yours, but that they will answer extremely well, and prove less expensive.

I am, Sir,

Your obedient Servant,

J. LEWIS.

Stradey Furnace, April 18, 1806.

To Mr. Le Caan.

Certificates

Certificates were also received from Mr. R. JONES of Swansea, Agent to General Ward's Colliery; from Mr. JAMES BARNES, who formed the Mythcr and Carmarthenshire rail road, and Mr. EDWARD MARTIN, of Morristen, an eminent Colliery, surveyor and planner of rail roads, all testifying the advantage of Mr. Le Caan's invention.

Reference to the Engraving of Mr. CHARLES LE CAAN'S *improved Tram-Plates for Rail-roads. Pl.* VI. *Fig.* 8, 9, 10, 11.

The Tram-plates, fig. 8 and 9, are fastened by means of a tenon and mortise A B, each having a correspondent bevel, just sufficient to keep the end from rising up, so that the head of one plate confines the end of the other; by this means, the workmen are obliged to form their road in right lines, and maintain perfect levels, as the mortise and tenon confines them to the required exactness necessary to make a perfect road: curves or any given segment may be formed with the same nicety, by having two bevel rails or plates made for such purposes.

Fig. 9. A side view or longitudinal section of the two plates placed on their stone blocks or sleepers C D, show two plugs in dotted lines, one bevel, the other perpendicular, cast in the stop-rail or plate, which is so called as it prevents the others from moving, and when taken up releases all those between the stop-plates; 25 yards of rail road made with these plates, may be taken up and replaced within ten minutes. The plugs in dotted lines are shown in their proper positions within the sleepers E F G.

The usual length of a tram-plate is three feet, the flanch or outside edge H, about one inch and half high, the sole or bed

bed I, from three inches and a half to four inches broad, and three-fourths of an inch thick, but these dimensions may be varied according to circumstances; the most approved weight has been 14 pounds to the foot, or 42 pounds to the plate, the ends from which the plugs project, and to which the tenons and mortises fasten, should be one-fourth of an inch thicker than the other part of the plate.

Fig. 10. A B, Show the under part of the tenon and mortise, and the form of one of the sloping or bevel plugs.

The diameter of the plug near the shoulder is one inch and three quarters, reducing to one inch, its length two inches and a half, forming an angle of eight degrees, the plate from which its projects is counter sunk, so that the shoulder of the plug may not receive any sharp pressure or prevent the plate from having a perfect bearing. There is a small groove in the whole length of the exterior of each plug, to admit a wire to pass to its extremity, to draw the plug out if broken by any accident, also to admit the expansion of water, in case of severe frost.

The blocks or sleepers, E F G, on which the tram-plates are placed, should by no means be less than 120 pounds each in weight, but should be heavier on some kinds of ground: the depth of the hole for the plug should be three inches, and worked according to the inclination of the plug, for which purpose the stone-mason should have a standard cast-iron guage; there should be projections, K, cast with the flanch or outside edge of the tram-plate, as shown at fig. 8, to make the plates lie firm on their sleepers.

Fig. 11. Is a section of one of the ends of a tram-plate, in which H shows the flanch or upright edge, I the flat part or sole on which the wheels of the waggons run, D one of the plugs, K the projection behind the flanch to make the plate lie firm on the blocks.

GENERAL OBSERVATIONS.

The advantages of laying plates on the above principle, is obvious; the blocks being put in their places never sink below their intended level, the act of driving either nail or plug, (which requires a considerable degree of force, and too frequently destroys the level of the road) being here unnecessary. In the common mode of making rail-roads, from the irregularity of nails, particularly in forming their heads, few can be driven exactly even with the plate, and are perpetually obstructing the passage of the waggon; the workmen frequently not proportioning their holes and plugs to the hole in the block, also occasions considerable breakage; the exertion necessary to fix a rail or plate completely, is great, and numbers of plates, particularly when the iron is short or brittle, are broken near the mortices by missing the stroke of the hammer, which must be used with great force.

Advantage gained in laying my Tram-Plates in Comparison with other Modes.

	£.	s.	d.
Nails used in a Mile, 3520 of 3 in the pound, at 4*d.* per lb.	19	11	0
Nails lost or defective, computed at per mile	1	0	0
Plugs with their loss	6	5	0
By Breakage of Rails, average from experience	7	10	0
Lessened by labour in Block laying, calculated at only two-pence per yard	14	13	4
By Breakage of Blocks	1	0	0
£.	49	19	4

This calculation does not take in annual loss of nails, and breakage of blocks, which is considerable.

The

The Sum of FIFTEEN GUINEAS *was this Session voted to Mr.* JOSEPH COLLIER, *No.* 11, *Crown Street, Soho, for an improved Ship Stove.*

The following Communication was received from him, and an Engraving is annexed.

A complete Model is placed in the Society's Repository.

SIR,

I HEREWITH send you a model of an improved ship stove, which may also be employed in drying houses, &c. with more safety than those in present use.

I submit it to the inspection of the Members of the Society, who, I make no doubt, will see its advantages, and am, Sir,

Your humble Servant,

JOSEPH COLLIER.

P. S. The expence of one twelve inches diameter will be about eight pounds.

Reference to the Engraving of Mr. Collier's Ship Stove, Plate VII. *Fig.* 1, 2, 3, 4.

Fig. 1. The stove, with the front partly closed by the circular slide A, which is moved from the back by the brass handle B. C a moveable plate attached to the slide A, now supported by the latch catching a pin, by which means it acts as a blower to cause the fire to burn more briskly, but which slides down also to shut the fire up.

D another plate, now hanging on its latch, but which can

can be let down to shut up the ash pit or dish I, which can be drawn out when the side facings FF are pulled up. G a circular plate or cap, which slides so as to shut the chimney up close.

Fig. 2. The body of the stove with the slider A moved round to the back, and thus leaving the fire-place completely open.

Fig. 3. The ash-dish shown separate.

Fig. 4. One of the side facings taken out to show the figure H, which slides into a hole made in the corner of the stove to hold it.

A LETTER OF THANKS *and the* SILVER MEDAL *were voted to the Founder of this Society, Mr.* WILLIAM SHIPLEY, *in the year* 1776, *for his ingenious and humane contrivance for saving the Lives of Persons who fall overboard at Sea, and for presenting a Machine for that purpose to the Society, which is placed in their Repository.*

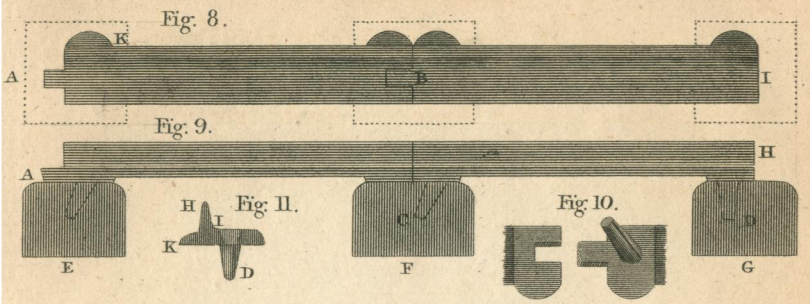
As this Invention hath not yet been published, and the Society consider it of too great utility to remain unknown, they have ordered it to be inserted in the present Volume, and an Engraving thereof to be annexed.

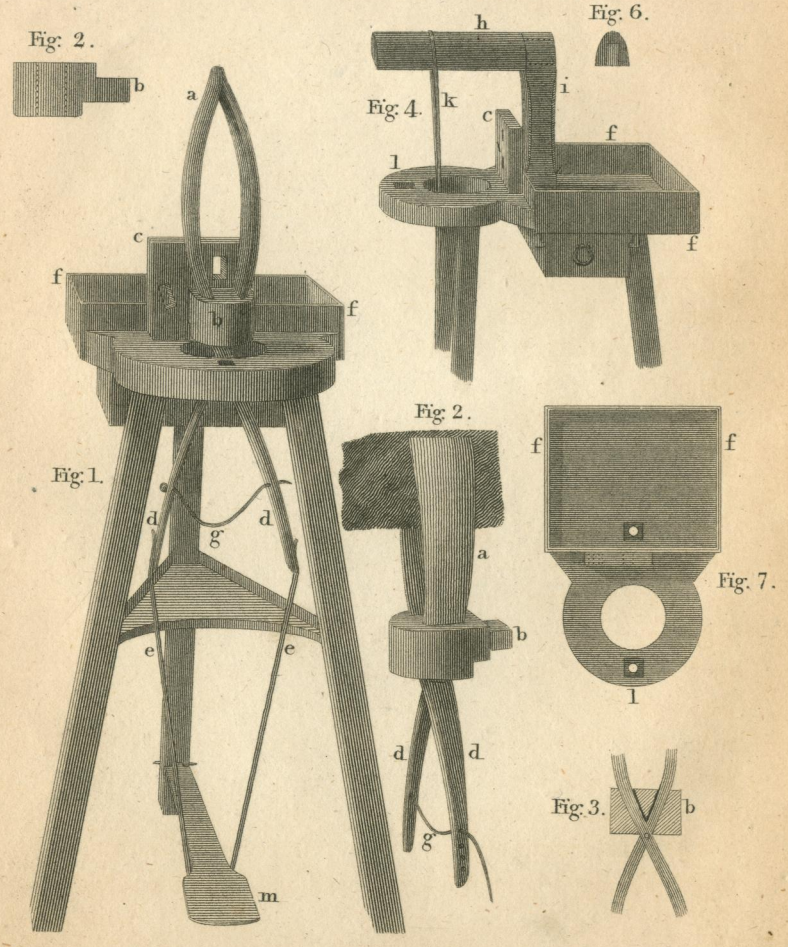
An Account of a FLOATING LIGHT *calculated to save the Lives of Persons who have the Misfortune to fall overboard in the Night from any Ship.*

GENTLEMEN,

IT is proposed, in order to make this float useful, that it be placed every night under the care of the officers on watch; that its lamp be frequently trimmed and supplied with

Mr. Charles Le Caan's Tram Plates.

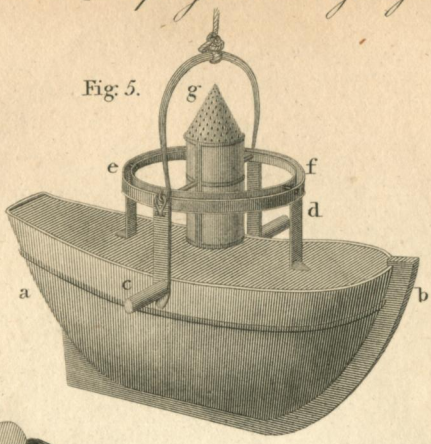


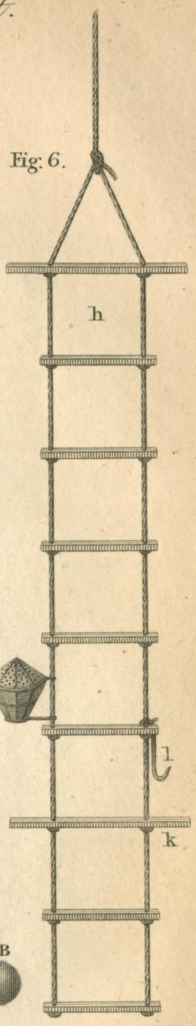


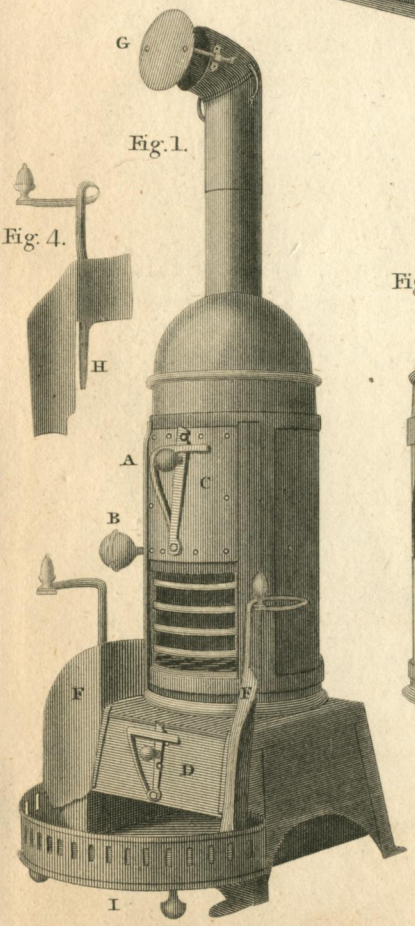
Mr. A. Staff's Machine for Boot-closing.

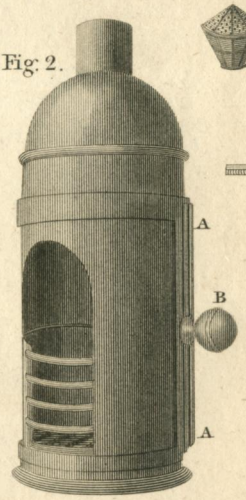
C. Varley del. S. Porter sculp.

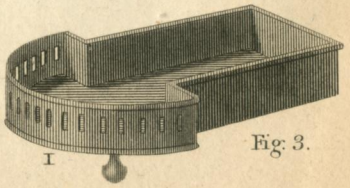
Mr. Wm. Shipley's Floating Light.











Mr. Joseph Colliers Ship Stove.

C. Varley del.
S. Porter sculp.

with fresh oil, and its wick moistened with oil of turpentine, in order that it may take fire with the least touch of a lamp or candle, and whenever the alarm is given of any of the sailors falling overboard in the night, the officer on watch may light the lamp in the lanthorn belonging to the float as expeditiously as possible, and let the float down by a small cord, wound upon an iron reel, into the water, till it has floated about one second of time, and the float is a little way out of the perpendicular of the small cord. He is then to secure the cord on the reel, to prevent its unwinding, and toss it overboard. The reel will sink down, and pull the line almost perpendicular, and thus it will not be liable to entangle the person when he swims to the float, who, when he has got hold of the handles of it, may move it very fast which way he will, only by striking his legs in the same manner as he does when he swims; and as the light of the lamp will be a certain guide for the person fallen overboard to find the float, so it will also direct them in the ship to find the manand float: And when the ship has tacked about, and is come to the float, then the following method is proposed to take up the man and float into the ship: viz. A lanthorn, with a rope ladder, may be let down by a cord from the ship, till a cross-bar below the lanthorn touches the water, which may be seen by them in the ship by means of the light from the bottom of the lanthorn, and thus the man in the water may lay hold of the cross-bar, and fix his feet on one of the steps of the rope ladder, and he may then lay hold of the iron bar or handle of the float with one hand, and hang it on the hook of the rope, above the cross bar, which being done, the man and float may be both safely lifted into the ship.

Reference

Reference to Mr. Shipley's Floating Light, Pl. 7, Fig. 5, 6, 7.

Mr. Shipley's floating light consists of a hollow vessel in the form of a boat, made of tinned iron plate, *a b*. Fig. 5, Plate 7, the joints of which are carefully soldered, so as to keep out the water. The boat is 27 inches long, 13 broad in the middle, and 12 deep, and is sufficient to support a man in the water. From the gunwale of the boat, on each side, projects a handle *c d*, soldered fast to it for the man to hold by.

e f is a metal ring connected with the boat, by four upright pieces, within which is another smaller ring, turning on pivots, fastened to the ring *e f*, in the direction of the *boat's* length; the internal ring supports a small lanthorn *g*, by an axis which passes through it, and is pivoted into the ring at each end, in the direction of the boat's length. By means of these rings the lanthorn will remain in a vertical position, independent of the boat's motion.

On the first alarm of a man falling overboard in the night, the candle is to be lighted, and the machine lowered into the sea by the rope; if the man should be at a small distance from the ship, he may, by means of the rope, be taken on board immediately on his reaching the machine, if not, the rope may be secured on the iron reel, to prevent its unwinding, and cast off, and the light will direct the man where to find it, and holding fast by the two handles it will support him in the water.

Fig. 6. *h* is a rope ladder, having a lanthorn attached to it, as well to direct the person in the water to the rope ladder, as to enable the persons who lower the ladder to let it down till the cross-bar *k* reaches the water; *l* is a hook to hang the floating light upon. Fig. 7. *m* is the reel for the line, by which the floating-light is to be lowered.

To the Society of Arts, &c.

The Miseries to which Children employed within the Flues in cleansing Chimnies are liable, induced this Society to offer Premiums in the Year 1802, *to obviate the Necessity of so cruel a Practice.*

In the Year 1806, *the Gold Medal was adjudged to Mr.* GEORGE SMART, *of the Ordnance Wharf, Westminster-bridge, for the greatest Number of Chimnies cleansed under his Direction by Mechanical Means, a Particular Account of the Method used by him for such Purpose will be found in the* 23*d Volume of the Society's Transactions.*

During the present Session, a Gold Medal has also been voted to him for the best Machine produced to the Society for the intended Purpose; an Explanatory Engraving of which having been given in the Volume above-mentioned, renders one unnecessary here.

The following Communication has been received from him, and a Complete Machine is preserved in the Society's Repository for Public Inspection.

SIR,

SINCE the middle of February last, I have been trying experiments in chimney-sweeping; my first was, stiffening a rope with whalebone, but found it would not be portable, and that it would be otherwise inconvenient, as in passing from one room to another in the same house, even with the greatest care, it would be almost impossible to avoid touching the paper on the stair-cases, particularly where they are narrow. In passing through

the street, with such a machine, it would be also very troublesome.

If the brush is made to fill the flue, which ought to be the case, a substance of an elastic nature has not power sufficient when the brush is forty or fifty feet up, especially where there are sharp turns in the flues; the force applied to send the brush up is principally spent in friction on the sides of flues, and of course would soon cut through any flexible substance that combines the whalebone, or other elastic substance used.

My next attempt was to join elastic rods together by screws in the joints, but this plan would not do in passing sharp elbows, as the joints would be strained, and soon unfit for use, and a danger of the joints slipping or breaking, which would leave the brush in the flue.

I then thought of the simple portable machine, I have sent for the inspection of the Society; its cheapness, durability, and power of execution, will, I hope, recommend it. I think with perseverance it will abolish the practice of climbing boys; I have used it in several lofty chimnies, and am convinced it may in time become general. I have also sent a rod and curtain that may be fixed to any opening of a chimney-piece, from six inches to five feet, without using nails or forks in the common mode, to the injury of the wainscot or chimney-piece.

My method of working the machine is, by first putting up the brush, then pressing forward one tube after another as strung upon the rope, till the brush meets with an elbow in the flue; then it is necessary to tighten the rope by pulling it under the feet, or by means of a small pulley, and putting in one of the small screws to pinch the rope; then make a fresh push, and by shifting the two screws, the one to relieve the

the other, it will pass the elbow and possess sufficient stiffness to allow the brush to be forced forward to any height.

I have tried the heath and hair-brushes, and find, that if the flue is well filled, it does not require so hard a substance as heath, as it brings down the mortar with the soot. The brushes of hair, and those formed from the article of which carpet brooms or whisks are made, I think will answer best for general use.

This is to certify, that Mr. GEORGE SMART, of Camden Town, by means of a machine of his own invention for sweeping chimnies, has made two experiments on my hall and parlour chimnies, to ascertain the practicability of raising the machine through their various windings. The first of these flues measures upwards of fifty feet from the hearth, and the operation was performed with apparent ease, sending down a quantity of soot, together with some wet mortar, although the flue had been recently swept by a regular chimney-sweeper. The other from the hearth measures sixty feet, and although there are no less than three elbows in it running in opposite directions, (as the *boy* informs me), the operation was performed within nine minutes.

JOHN TROTTER.

Soho-square, May 2, 1803.

Certificates were also received from Mr. H. W. DIETRICHSEN, of Pratt-place, Camden Town; Mr. CHARLES MILL, No. 4, Gloucester-place, Camden Town; Mr. JOHN MASON, and the Rev. JEREMIAH JOYCE, of Camden Town, testifying that they had seen Mr. Smart's machine at work, and that they approved thereof.

SIR,

I HAVE the pleasure to inform you, that my machine for sweeping chimnies succeeds far beyond my expectation, and that I am not able to attend to one-half of the orders I could have for its use.

His Royal Highness the Prince of Wales, has directed that the chimnies at Carlton-house, also those at the Pavillion, shall for the future be cleansed by my machines. I have also had orders to send to different parts of the kingdom my machines ready-made, where they have been the means of providing a comfortable subsistence for poor persons not capable of other business.

The price of a machine to ascend 60 feet, including rod, curtain, extra brush and box, is 4*l.* 14*s.* 6*d.*

There are two particular advantages attending my machines; namely, that of sweeping a great number of narrow flues which no child can get up, and that of extinguishing chimnies when on fire, by placing a wet cloth over the brush, and forcing it up the chimney.

The construction of the machine is so fully shewn by the description and engraving of it in page 256, of the 23d volume of the Society's Transactions, that it will be unnecessary to say more upon the subject.

I am, Sir,

Your humble servant,

GEORGE SMART.

Ordnance Wharf, Westminster-bridge.
Dec. 21, 1805.

To C. TAYLOR, M. D. SEC.

The

The SILVER MEDAL *was this Session voted to Mr.* JOSEPH DAVIS, *No.* 14, *Crescent, Kingsland-road, for his Machine for cleansing Chimnies, without the Use of Climbing Boys, being considered the Machine next in Merit.*

The following Communication was received from him; an Explanatory Engraving is annexed; and the Machine is preserved in the Society's Repository.

SIR,

I HAD the pleasure of submitting to your inspection, a model of a machine for the purpose of cleansing chimnies, on the 3d of May 1803, and which I wished to be brought before the Society of Arts, being convinced that the approbation of so respectable and enlightened a body of men, would greatly tend towards the superseding the use of climbing boys; and I shall, therefore, feel myself greatly obliged if they would examine the machine, and favour me with their opinion on it.

I am, Sir

Very respectfully yours,

JOSEPH DAVIS.

No. 14, *Crescent, Kingsland-road, Jan.* 6, 1806.

To C. TAYLOR, M. D. SEC.

SIR,

THE brush part of the model of my machine for cleansing chimnies, which I sent you on the 3d of May 1803, not having any hair in it, I am now enabled to forward you one in a more perfect state, and which I had the honour of

using in the presence of his Lordship the Bishop of Durham, at the Military Hospital, Westminster, on the 11th of June 1803, and at the Jennerian Society, in Salisbury-square, Fleet-street, on the 22d of the same month, and in the same year;—a certificate of which signed by the gentlemen who were present, I had the pleasure of sending you. I have also sent three lengths of the rod, (the same as those which were used at the above places,) in order to enable the Committee to judge with greater ease of the construction. Permit me nevertheless to observe, that the principle of my rod is so simple and secure, that it may be used in almost every chimney with safety, either by the maid servant, or a boy of twelve years of age; it is calculated both for private and public use, and a stranger to the machine who used it at the Military Hospital, declared he could sweep any chimney with it, the plan was so good. It will also sweep German and other stove pipes, and flues of almost every description. If the gentlemen of the Society will do me the honour to take the machine into their consideration, I will wait on them by hearing from you, and explain further particulars.

I am, Sir,

Your obedient Servant,

JOSEPH DAVIS.

No. 14, Crescent, Kingsland-road, March 18, 1806.

To C. TAYLOR, M. D. SEC.

Certificate of Approbation of Mr. DAVIS's *Machine.*

We hereby certify, that we were present and did witness the trial of Mr. Joseph Davis's machine for the cleansing of chimnies,

chimnies, and superseding the necessity of climbing boys, two separate times in the month of June 1803; first, at the Military Hospital, Westminster, on the 11th of that month, and again, on the 22d, at the Jennerian Society, Salisbury-square, and we are of opinion, if this machine was made use of, it would answer the purpose, and, (if not wholly) in a great measure prevent the necessity of the present practice.

B. M. FORSTER, Threadneedle-street.
JOSEPH LEAPER, 157, Bishopsgate Without.
JAMES HEBDIN, Queen-street, Westminster.

SIR,

I AM glad that I have had an opportunity of giving my opinion of your machine for cleansing chimnies, which I have done by signing the certificate you brought to me on Monday last. I am opinion, that your machine is capable of sweeping a very great proportion of the chimnies in London and elsewhere; perhaps there are not more than one or two in a hundred which it cannot be raised in. At present, there are (as is well known to all chimney sweepers) some chimnies so small, that boys cannot climb them, so that on the whole, I imagine that your machine will sweep about the same number of chimnies as are swept by boys, though not exactly the very same flues in every instance.

I hope in time we shall convince the public, that they can have their chimnies swept with as much cleanliness and as effectually with machines, as they have heretofore had them

done; and I am convinced that they may be swept as cleanly and effectually, as is commonly done with climbing-boys, so that the difference to the families who employ your machine will be, that they have the same comfort of a clean chimney, and are satisfied that they no longer use a method which is full of horrors and a disgrace to a civilized country.

I remain, Sir,

Your obedient Servant.

B. M. FORSTER.

Threadneedle-street, Oct. 17, 1804.

Reference to the Engraving of Mr. Davis's Machine for cleansing Chimnies, Pl. 8. *Fig.* 1, 2, 3, 4.

Fig. 1. Represents the upper part of the machine; A A A A, are four brushes for sweeping the four sides of the chimney, they are hinged to the bottom of a tube about three inches diameter; B B, show two of the four springs which expand the machine to chimnies of all sizes. The heads of the brushes are made about six inches long, and five wide; and form portions of cylinders, the hair being left longer at the top than the bottom. The hair at the ends of the brushes being left still longer, namely, three and half inches, for the purpose of sweeping the corners of the chimney. C, represents the brush at the top of the machine proper for cleansing the pots; the machine may be used either with or without it, but it is very useful for cleansing stove pipes by being used alone; it is secured to the top of the rod by means of a spring and socket, as

the

the rods below mentioned. D D D D, four lines to draw the brushes near together by a cord E, so that the machine may be forced up the chimney with greater facility. F, the string to expand the brushes when the machine is at the top of the flue.

Fig. 2. Shows on a larger scale the top of one of the rods separate. G, the spring attached to it.

Fig. 3. Explains the manner in which the rods are joined together. H, being a brass socket fixed at the lower end of each rod; the spring G, and upper end of the rod fig. 2, are pressed into this socket so far, that a small point I, on the upper end of the spring, rises through a small hole in the brass socket, and retains the lower rod in the socket. Each rod is made of hiccory wood, which being tough and flexible, is particularly well calculated for this use, bending and adapting itself to the different turns it meets with.

Fig. 4. Shows the key to unlock the rods; it is six inches long and made from a piece of one of the rods, with a steel stud K, in the middle rising a quarter of an inch, and a brass plate on one side projecting the thickness of the rod to guide it into the socket, that it may be used without looking at the rods.

The method of cleansing the chimney is, by first entering the brush part of the machine with the brushes closed, and one of the rods attached to it up the chimney, the head of a second rod is then slided as above-mentioned into the socket of the first rod, and the brush by it forced higher up, a third rod is then slided into the socket of the second, and this mode continued till a sufficient number of rods are added to raise the brush to the top of the chimney. The string E extending from the brush to the bottom of the chimney, being then pulled, occasions the four brushes

to expand to the width of the flue, and to bring down with them in their return all the soot which adhered to the sides of the flue. As the machine is drawn down, the rods are separated one by one by means of the key, and laid upon the hearth till the brush part is brought down, which is then closed and laid with the rods.

The usual precautions must be taken of placing a curtain before the fire-place, to prevent the soot whilst falling from flying about the room.

JOSEPH DAVIS.

TEN GUINEAS *were this Session voted to Mr.* JOSEPH DAVIES, *No.* 14, *Crescent, Kingsland-road, for his Invention to secure the Pannels of Doors and Window-shutters from being cut out by House-breakers.*

The following Communications were received from him, an Engraving is annexed, and a Model is placed in the Society's Repository for the Inspection of the Public.

SIR,

I HAVE for some time considered that it would be of great benefit to the public, if a plan could be adopted to prevent the pannels of shutters or doors being cut out by house-breakers; and having tried a great number of experiments, I have at length succeeded in accomplishing the one I have the honour of forwarding to the Society for the Encouragement of Arts, &c.

This improvement consists in introducing tempered steel

Mr. Mendham's Escapement.

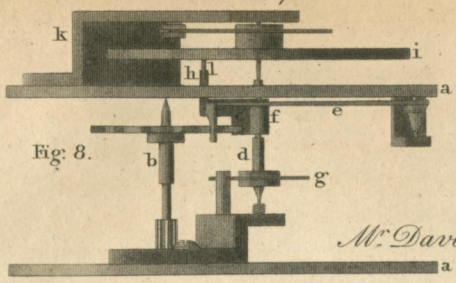


Fig: 8.

Fig: 9.

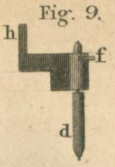


Fig: 4.

Mr. Davis's Chimney Brush.

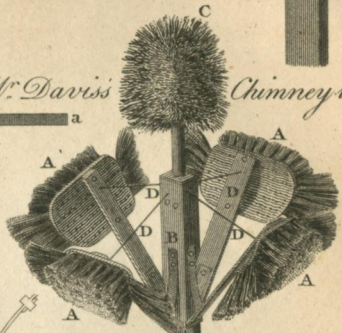
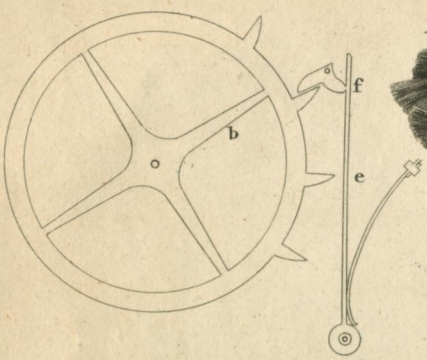


Fig: 1.



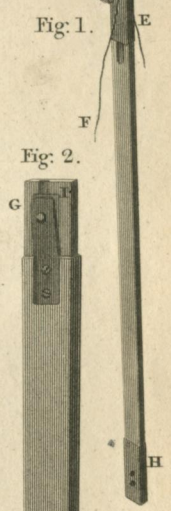
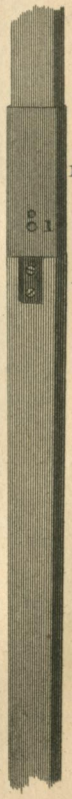


Fig: 2.



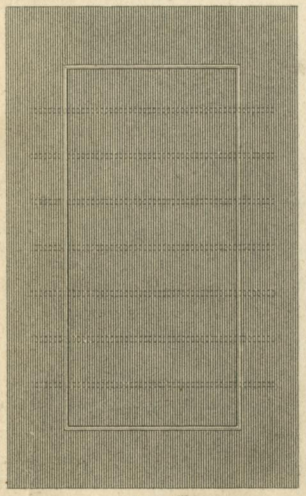


Fig: 5.

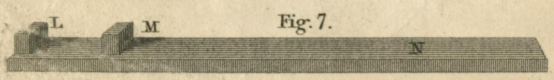


Fig: 7.

Mr. Davis's Pannels for Security.

C. Varley del.

S. Porter sculp.

steel wires through the pannels and stiles at the distance of three inches, thereby not only making a door or shutter far superior in strength, but calculated to defy the attempts of the house-breaker in taking out a pannel. This improvement, though so far superior to any hitherto known for appearance and utility, will be attended with less expence. I have submitted the above plan to Messrs. Paynters, Coleman-street, likewise Messrs. Moffatt and Co. Paternoster-row, and to several gentlemen in that line of business, who all do me the honour to say, that it far surpasses any thing of the kind, that they have ever known or conceived, and that it will completely answer the purpose.

I have also sent the machine on which I bored the pannel, conceiving it to be an additional recommendation; with this machine, a boy may with ease bore the shutters, &c. which other ways might be difficult for a man to accomplish.—I have the pleasure most respectfully to subscribe myself,

SIR,

Your very humble Servant,

JOSEPH DAVIS.

No. 14, *Crescent, Kingsland-road,*
April 14, 1807.

To C. Taylor, M. D. Sec.

Certificate.—We hereby certify, that Mr. Davis's improvement on doors and shutters, to prevent the pannels from being cut out by house-breakers, is the best that we have ever seen; and we are of opinion, that its being known will be an advantage to the public, and do therefore recommend

mend it to the Society for the Encouragement of Arts, Manufactures and Commerce, for their consideration.

F. PAYNTER, and Co. Coleman-street.
E. COLEBACH, Minories.
J. TEASDALE, Paternoster-row.
W. ROLFE.

April 22, 1807.

Reference to the Engraving of Joseph Davis's Invention for securing Window and Door Pannels. Pl. S. *Fig.* 5, 6, 7.

Fig. 5. Represents a wooden pannel made in the common way, the dotted lines show the situations of the tempered steel rods within the pannel, the holes through which the rods were introduced on one side being closed up.

Fig. 6. Shows a section of the same, the small dots in the engraving, denoting the place of the rods.

Fig. 7. Shows the instrument on which the pannels are laid to be bored. The borer passes through the holes L M of the two upright pieces which keep the borer in a straight line to act upon the pannel laid upon the frame N.

The SILVER MEDAL *of the Society was this Session voted to Mr.* S. MENDHAM, *Counter-street, Borough, for a Watch Escapement.*

The following Communication was received from him, an Explanatory Engraving is annexed, and a Model is preserved in the Society's Repository.

SIR,

I BEG leave to lay before the Society, a model of a new escapement, the principle of which is, that the balance acts without

without friction, and the movement in itself very simple; the impulse is given without jarring, the inequality of power through the train, has no perceptible effect on the balance; and no additional weight, however great, can produce more than a regular and gentle increase of impetus on the balance.

I remain, Sir,

Your most obedient Servant,

S. MENDHAM.

7, Counter-street, St. Margaret's-hill, Borough, Sept. 21, 1805.

To C. TAYLOR, M. D. SEC.

SIR,

HAVING attended the Committee upon Mr. Mendham's escapement, I think it a justice due to a man of genius, to give my opinion further upon it.

In viewing mechanical improvements, we should not confine our ideas to their present properties, but should consider what improvements the principle will admit of.

As the principles of Mr. Mendham's escapement, and that of Mr. Mudge's, which obtained a bounty from government, are much the same, I shall compare the one with the other.

The impulse given to the balance without friction, is exactly the same as Mudge's. The remontoir is bent up by the maintaining power in a similar way to that of Mudge's, but from the form of the pallet, which is a plain surface,

surface, it is not so perfect. Mudge's, from the form of the pallet, bends the remontoir always to the same place, the other is bent higher or lower according to the force of the maintaining power, but by forming the pallet like Mudge's it would render them alike in that respect. The only other objection is the spring detent that detains the wheel, when it drops from the pallet of the remontoir; it is the same as that of a detached escapement, consequently exposed to the whole force of the maintaining power. To compensate for these objections, the arc of vibration is not limited like Mudge's, which is of great importance, and having only one remontoir, it is more simple. It is, therefore, superior to Mudge's in having only one remontoir, and being unlimited in the arc of vibration, it is superior to the detached escapement in giving the impulse without friction.

I am, Sir,
Your very humble Servant,
THOMAS RAMSAY.

Islington, Feb. 11, 1807.

To C. TAYLOR, M. D. SEC.

Reference to the Engraving of Mr. S. Mendham's Escapement. Pl. 8. *Fig.* 8, 9, 10.

In the escapement referred to, there are two principal peculiar properties in the invention, both which I consider superior to any thing of the kind laid before the public; first, the balance is kept in motion without any friction whatever, and in a manner so simple, that even movements of inferior workmanship must go with great accuracy.

Being not in this line of business, or acquainted with any persons in the trade, where I might have had an opportunity

nity of examining different escapements, I certainly labour under many disadvantages, for since I have been honoured with the Society's medal, I have heard of an escapement by which the balance is kept in motion without friction, but being limited in the arc of vibration, complicated, and very expensive in the movement, it renders it much inferior to mine.

In the second place, the balance is kept in action by an impelling power without any blow whatever; all other escapements which have fallen within my notice have kept up the vibration by a direct blow virtually on the balance itself, which I have always considered to be a great disadvantage, for a blow upon any thing of the nature of a spring, produces that kind of shock which can by no means be convenient or serviceable in keeping a steady motion, which is so essentially necessary, but is on the contrary disadvantageous.

The figure, plate 8, fig. 8, represents the escapement without the rest of the train; *a a* are the two plates of the frame between which the train runs; *b*, is the last or balance wheel of it, with teeth nearly similar to that of the balance wheel of an eight-day clock, moving with the flat face of the tooth forward against the pallet *c* of an upright spindle *d*; *e* is a locking spring nearly similar to a detached one, having no extra spring to pass to and fro with. Above the pallet *c*, is a very small one, *f*, which is for the purpose of unlocking the wheel, which is better shewn in fig. 9; at the lower part of the spindle *d*, is a hair spring *g*, so pinned as to bear the pallet *f* against the locking spring with sufficient power, so that of its own accord it frees the wheel and lays the pin *h* which comes through the plate gently up to the stop, consequently the tooth falls upon the pallet *c*, but

but so close home to the centre of the spindle, that it has no power to pass it of its own accord; the pin *h* referred to, is fixed to the top extremity of the pallet *c*, and rises perpendicularly through the plate *a* some way above the surface.

The balance *i* is fixed on the centre of its spindle, principally on account of equalizing the weight, besides which it is the most convenient to be so; it is supported between the plate *a*, and the cock *k*, precisely over the spindle *d*, consequently the action of each is in the same arch, and the connection is between the pin *h* of the pallet, and the pin *l* of the balance, (a pin fixed in the balance at the same distance from its centre as the pin *h* is from the centre of the spindle *d*, and sufficiently long to touch the pin *h* sideways,) there is therefore no friction whatever between them.

Having mentioned the different parts of the escapement, I shall proceed to explain its action. The immediate course of vibration is from the spring *g*, the balance spring is so placed that the pin *l* of the balance stands near the pin *h* of the pallet; it is to be remembered that the tooth of the wheel rests on the pallet during the vibration of the balance, so that when the balance is put in motion, the pin *l* comes in contact with the pin *h*, which stands perpendicularly almost imperceptibly fine, and carries it back; as soon as moved, the tooth of the wheel gives it an extra assistance of about one-fifth of a circle, passes and lays the next tooth on the lock; on the return of the balance, the spring *g* applies all its power in urging the balance forward till it comes to the stop, the balance then maintains its motion, and the small pallet *f* having unlocked the wheel, the tooth falls again on the great pallet *c*, and waits the return of the balance.

The balance carrying the piece *h* back, forms a most admirable

admirable banking without any extra apparatus, which is generally done by some kind of stop on the hair spring, which must have an irregular effect; the further the pin is carried back, the stronger the spring operates against it, and from the extent where the piece may be forced back to, there is play for near two whole circles of vibration, without any possibility of upsetting. The balance of the model vibrates about a circle and one third with extraordinary freedom, *though* a course train of four wheels, a large and heavy balance, with only the power of a stout watch spring. I therefore think the power necessary to carry a train with this escapement, may be considerably less than any other of a detached nature.

Fig. 9. Represents the axis *d* shewn separately, in order that the arm and pin *h*, and little pallet *f*, may be seen more distinctly.

Fig. 10. Shows the balance wheel *b*, and the method of locking and unlocking.

S. MENDHAM.

The SILVER MEDAL *of the Society was this Session voted to Mr.* WILLIAM HARDY, *No.* 13, *St. John-street, opposite the Dispensary, Clerkenwell, for equalizing the long and short Arcs of Vibration in Time-keepers.*

The following Communication was received from him, an explanatory Engraving is annexed, and a Model of the Invention is preserved in the Society's Repository. See Plate 9. *Fig.* 1, 2, 3, 4, 5, 6.

SIR,

THE equalization of the time of the different arcs of vibrations of the balance of a time-keeper, having lately

given to rise much discussion, I beg leave to offer for the approbation of the Society, three different modes of obtaining this end. The first method is by a straight spring placed edge-ways across the diameter of the impellent pallet *a*, fig. 2 and 3, and screwed at the end opposite to the direction of the wheel, on its approach towards the centre of this pallet; at the other extremity of this spring is a flat face, or curved surface, to receive the approaching tooth of the escape wheel, which gives the impulse; this spring acts between two pins placed in the pallet near its end. By reducing this spring to a certain degree of strength, so that it may yield a little to the force of the wheel in giving the impulse, the different vibrations will be performed in the same time; but the proper degree of strength can only be determined by repeated trials. This method possesses besides, this farther advantage, that the acting surfaces are not so liable to be injured by the drop of the wheel upon the spring, as upon a solid surface, nor the vibrations of the balance so much disturbed by the impulse. The second method is by a straight spring *b c*, fig. 1 and 4, screwed to the under part of the cock, placed edgeways and diametrically over the cylindrical spring, and having a piece cut out to clear the arbor of the balance. This straight spring is at one extremity fastened to the end of the pendulum-spring, and, at the other extremity, its elasticity is reduced so as to yield a little before the pendulum-spring operates; on the opposite of the cock, where the spring is screwed, is fixed a stud *d* projecting downward, and having a slit to admit the small piece at the end of the spring *b*; on each side of this slit is an adjusting screw *e e*, whose points face each other, and are placed so as that the spring may move equally between them from its point of rest. The action of the spring between

between the adjusting screws, requires to be somewhat less than the angle of escapement. Let the balance be made to vibrate, so that the straight spring may move up to the adjusting screws upon each side, and no farther, being weaker than the pendulum-spring, its exertion will be less; hence the time of the vibrations will be prolonged, but as they increase, the exertion of the pendulum-spring will commence and progressively accelerate them, and this acceleration will always be in proportion as the exertion of the pendulum spring is to the action of the straight spring between the two adjusting screws. Thus it will always counteract the accelerating effect of the escape-wheel in the small arcs of vibration, so that the whole of them shall be performed in the same time. The third method is by connecting a piece of short spring-wire to the pendulum-spring, by a small piece *f*, fig. 5 and 6, with two holes, and pinning the two springs together about half a turn from the stud of the pendulum-spring, and clamping the other end of the short spring at its natural point of rest to a sliding piece, *g*, which projects out from the pendulum-spring stud. By this manner of fastening, both springs will act together, and each will retain their natural point of rest; but by moving the sliding piece, which clamps the end of the short spring, and placing the spring a little on the strain, in opposition to each others exertion, the point of rest of both springs will be destroyed. Thus by producing this counteracting force in the two springs at the lowest point of vibration, the accelerating effect of the escape wheel upon the balance in the small arcs of vibrations will be corrected, thereby the whole of them will vibrate in equal time.

I am, Sir,

Your obedient humble servant,

No. 13, *St. John's-street, Clerkenwell.* WILLIAM HARDY.

To C. Taylor, M.D. Sec.

Extract from Captain William Brown's Letter, addressed to Mr. John Nichols, Millpond-bridge, Bermondsey.

Respecting the chronometer which I purchased from Mr. William Hardy last year, the jolting of the coach in the conveyance to Liverpool, altered its rate of going to 34″ slow, which rate it continued so exactly, that in making Cape De Verd, on the coast of Africa, (the longitude of which has been correctly ascertained) in 24 days from Liverpool, and carefully measuring my distance to the Cape, I could not discover it to have deviated from that rate, say 34″ slow, not one second in the whole time; and I have every reason to believe, that it continued the same rate until my misfortune, when it got immerged in sea-water, having lost my ship on a shoal five or six leagues from the Riopongas, this dangerous bank not being laid down correctly, nor the latitude nor longitude given in order to avoid it.

Liverpool, April 26, 1807.

To Mr. W. Hardy.

The Silver Medal *of the Society was this Session voted to Mr.* Henry Ward, *of Blandford, in Dorsetshire, for a Compensation-pendulum for a Clock or Time-piece.*

The following Communication was received from him, and an explanatory Engraving is annexed.

A complete Pendulum, and Drawings thereof, are placed in the Society's Repository.

SIR,

Herewith I send you a new compensation-pendulum, which I beg you will lay before the Society of Arts for their

their inspection. I trust their liberality will be equal to the advantages that may be seen to result from it, together with their consideration of the pains I have bestowed in making it. It has me cost much labour, time, and expence, indeed, it has occupied almost the whole of my attention for the last nine months.

If any objections should be made to it, I will endeavour to answer them, and make any further experiments required.

I am, Sir,

Your obedient Servant,

HENRY WARD.

Blandford, March 8, 1806.

To C. Taylor, M. D. Sec.

Reference to Mr. Ward's Compensation-Pendulum.
Pl. 9. *Fig.* 7, 8.

Fig. 7. *h h i i.* Are two flat rods of iron or steel, about half an inch wide, and an eighth of an inch thick. *k k* Is a rod of zinc interposed between them, and is nearly a quarter of an inch thick. The corners of the iron rods are bevelled off, that they may meet with less resistance from the air; and it likewise gives them a much lighter appearance. These three rods are kept together by means of three or four screws *l l l l*, which pass through oblong holes in the bars *h h k k*, and screw into the rod *i i*. The rod *h h* is connected to the one *k k* by the screw *m*, which I call

the adjusting screw. This screw turns in the rod *h h*, passes through the zinc rod *k k*, and screws into the iron rod *i i*. The rod *i i* has a shoulder at its upper end turned at right angles, and bears on the top of the zinc rod *k k*, and is supported by it. It is necessary to have several holes for the screw *m*, in order to adjust the compensation. See fig. 8.

Now it is evident, that if any degree of heat or cold be applied to this compound rod, that the one of zinc expands and contracts as much as the two iron ones together; the distance from the point of suspension to the centre of oscillation must remain the same.

In proportioning the length of the rods, I made use of Mr. Smeaton's table of expansion of metals, in the 48th Vol. of the Philosophical Transactions: where he shews, by experiments made with a pyrometer, that the expansion of iron is to that of unhammered zinc, with the same degree of heat as 151 to 353, and to that of zinc hammered, half an inch per foot, as 151 to 373. This great expanding property of zinc renders it in theory extremely fit for the purpose of compensation in a pendulum, and I was desirous of knowing if it would answer in practice, and likewise the exact proportion that was requisite to answer the intended purpose,

I made two regulators whose pendulums were composed of iron and zinc, as above described, with this difference, however, that one had a detached scapement of a particular construction; the zinc rod was not hammered, the ball of a lenticular form, and weighed twenty pounds, its arc of vibration nearly five degrees. The other had a simple remontoiring scapement, the zinc rod was hammered half an inch per foot, the ball, of a spherical form, weighed forty six pounds, and vibrated two degrees and three quarters.

These

These regulators were both placed in the same room, and their cases firmly fixed to the wall; the pendulums were suspended from a stout brass cock, screwed to the back of their respective cases. In the inside of each case, and immediately behind the pendulum rod, was hung a thermometer, for the purpose of comparing the degrees of heat. I adjusted them to mean time nearly by corresponding altitudes of the sun. After having compared them together for several days, I found that the one which had the hammered zinc rod went somewhat faster when the air of the room was heated by a fire in the grate than the other did. Hence I concluded that the difference of expansion of hammered and unhammered zinc was greater than Mr. Smeaton made it, at least it appeared so in this instance.

But to determine whether the length of the hammered zinc rod was accurately proportioned to that of the iron ones, I wished next to prove, without waiting that length of time that nature would require to produce a sufficient alteration in the temperature of the air, I proceeded to make the following experiment: I caused to be made a tin tube six feet long, and two inches and a half diameter at its larger end, from whence it gradually tapered to the other, which was only half an inch diameter. Within the case, and as far from the pendulum as possible, I placed this tube; the smaller end was carried through a hole in the top of the case, and projected a few inches above it. In the lower end of the tube was inserted the nozzle of a lamp, and immediately under it, in the bottom of the case, was a hole of an inch diameter to supply the lamp with air. By this means the tube would communicate as much heat to the internal air, as to raise the thermometer about thirty-five degrees.

Previous to the lamp being put in the case, I made both

pendulums vibrate exactly together, and after an interval of twenty-four hours, the one with the hammered zinc rod had gained, as near as I could judge, one tenth of a second. The mean height of the thermometer was fifty-three degrees. I now lighted the lamp, and in about four hours every part appeared to be thoroughly heated, and the thermometer arrived at its maximum, which was eighty-eight degrees; at this point it continued with little variation. While the heat was increasing I found the motion of the pendulum was accelerated. I again made them beat exactly together, and in about ten hours after, the heated pendulum had gained one second; the thermometer in the other case continuing nearly the same. The lamp was then taken out, and as soon as the parts were cooled, and both thermometers shewed the same degree, I adjusted the beat of the pendulums as before, and, at the end of twenty-four hours, I found the pendulum that had been heated kept precisely the same rate as it did before the experiment was made.

By this experiment the zinc rod was evidently too long, and that by a considerable quantity. The pendulum was then taken down, to have more holes made for the adjusting screw, and after many repeated trials with the lamp and tube, as before, I found the length of the zinc rod to be 22 inches, and consequently the length of the iron ones together $39{,}2 \times 22 = 61{,}2$ inches, or, the expansion and contraction of iron to that of zinc hammered, half an inch per foot, as 151 to 420.

Having thus far satisfied myself with the hammered zinc rod, I proceeded to make similar trials with the one that was unhammered; in doing which a circumstance occurred that I cannot account for, that when the air in the case was rarified by means of the lamp and tube, the arc of vibration

vibration would be about half a degree less than it was before the lamp was applied, which is directly contrary to what I should expect would have taken place. I afterwards found that the other pendulum was affected the same way, but in an extreme small degree, which, without doubt, was in consequence of the ball being much heavier, and vibrating a smaller arc. In taking the rate of the clock when the lamp was in the case, I at first computed from theory the error that would arise by such a diminunition of the arc, and allowed for it accordingly; but doubting whether the unlocking of the swing wheel might not form a decrease of velocity in the pendulum, and have a greater tendency to retard its motion, I therefore thought the experiment would be rendered more accurate if the maintaining power was increased until the arc of vibration should be the same. After several trials I found the length of the unhammered zinc rod to be about twenty-nine inches, which agrees pretty nearly with Mr. Smeaton's experiments; that is, in regard to the relative expansion of iron and unhammered zinc.

The zinc rod of the pendulum, which I here send to the Society of Arts, was hammered three quarters of an inch per foot; and by making experiments with it as I had done with the other two, I found the length of it to be twenty-two inches, which is exactly the same length as the one that was hammered half an inch per foot, so that it seems nothing is gained after hammering it to a certain degree; but I cannot think that any rule can be laid down to enable us to judge of the degree of expansion that will take place with a determinate increase of heat, from the quantity that is extended by the hammer; much depends on the degree of curvature and polish of the stake and hammer, and probably on the heating of the rod at the time; for

for it is necessary to heat it a little hotter than boiling water, otherwise it will crack in hammering.

In all these experiments it is to be understood that the ball of the pendulum was suspended by its center; but if the ball be made to rest on its lower edge, the expansion and contraction of it must be taken into consideration.

It has been the opinion of some mechanists that zinc is an unfit substance for a compensation-pendulum, because they have thought it too soft for the purpose, and that after being heated or cooled to a considerable degree, it does not return to its original dimensions. If that was really the case, no doubt but it would be a general one common to all metals in a greater or less degree; but from the experiments and observations I have made on zinc pendulums, I am fully satisfied there is no foundation whatever for such an opinion. Some time in the latter part of last summer, I however noticed a circumstance that made me doubt the matter—for when I first used any zinc pendulum, I never could bring the clock to keep the same rate two days together, but that it was continually retarded, whether I used the lamp or not; and had I not before observed a similar effect on a lever pendulum that was made of brass and steel, I should have ascribed the cause wholly to the softness of the zinc rod; but by constantly comparing its daily rate with one that had been going a longer time, I found this retarding property gradually wore off, and in less than a month would become quite settled to the rate that it would afterwards keep. By subsequent experiments with the lamp too, I have constantly found that all the pendulums I have hitherto tried kept precisely the same rate, both during the time they were heated (provided they were properly adjusted) and afterwards,

terwards, as they had done before. The cause of this retardation appears to me to be, that the points of contact of the different pieces, which compose the pendulum, are more closely connected after a little time than they are at first, that is, those points of contact do, by the weight of the ball, yield to each other in a smaller degree, until they get a broader bearing.

The advantages of this pendulum are, 1st, that from its simplicity it will never fail to have the desired effect. 2ndly, That no extraordinary care is requisite in executing it. 3dly, That the compensation may be increased or diminished with the greatest ease, without stopping the clock more than a minute, by making fast one of the screws that keep the rods together whilst the adjusting screw is removing, taking care to release it again afterwards; and, 4thly, That it can be manufactured for less expence than any other compensation pendulum hitherto published.

N. B. The compensation of this pendulum which I now send to the Society of Arts is properly adjusted, at least very near the truth. The holes for the adjusting screw are made at such a distance from each other, that by removing the screw one hole, it will produce an alteration in the going of the clock of about a quarter of a second per day with a change of thirty degrees of Farenheit's thermometer.

SIR,

SIR,

PERMIT me to state to you the observations I have made since my compensation-pendulum was laid before the Society.

The regulator, with the hammered zinc rod, and ball of forty-six pounds weight, was firmly fixed to a brick wall at the top of my house. The adjustment of the length of the rods, by means of a lamp, was repeated as before. There was, however, an alteration necessary to be noticed; the ball of the pendulum rested on its lower extremity, instead of being suspended by its centre. I prefer this method, as being less liable to error if the rods should be affected by heat or cold, quicker than the ball. The length of the zinc rod, as ascertained by the lamp, was now found to be $20\frac{1}{4}$ inches.

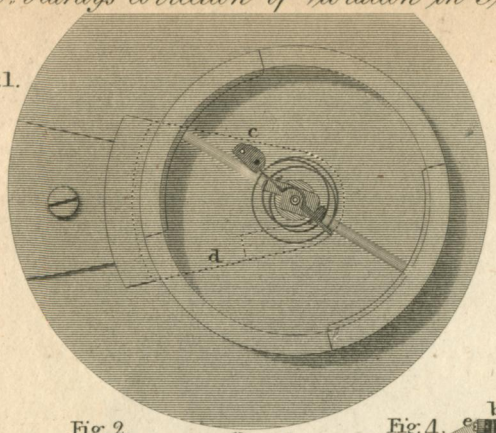
The clock was then set to mean time, and suffered to go without alteration; the result is exhibited in the following table.

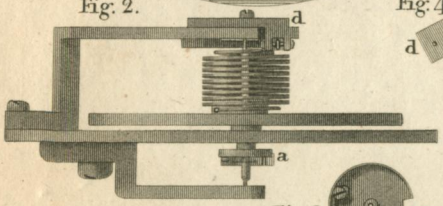
1806	Error of Clock at time of observation.	Number of Days between the Observation.	Daily rate
March 21	0″ 0		
April 8	× 2, 8	18	× 0″, 15
May 10	— 8, 7	32	— 0, 18
26	— 21, 5	16	— 0, 80
June 21	— 50, 0	26	— 1, 10

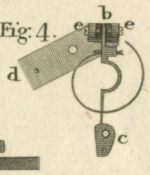
Increased the compensation for heat and cold, 6 holes $= 4\frac{3}{4}$ inches, or, the length of the zinc rod 25 inches. The clock was again set to mean time.

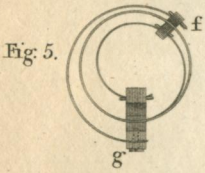
July

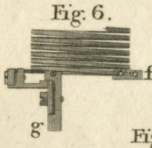
Mr. Hardy's correction of Vibration in Time Keepers. Pl. 9.











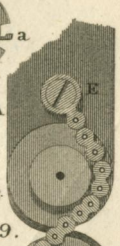
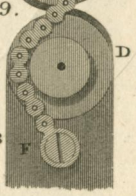
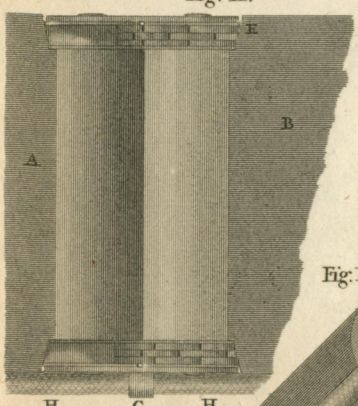


Fig. 9.





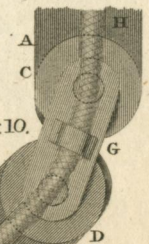


Fig. 10.

Mr. Furniss's Air Tight Door Hinge.

Mr. Henry Ward's Compensation Pendulum.

C. Varley del.

S. Porter sculp.

July 1	0″, 0	26	— 0″, 36
27	— 9, 3	13	— 0, 21
Aug. 9	— 12, 0	7	— 0, 31
16	— 14, 2	28	— 0, 34
Sep. 13	— 24, 0	12	— 0, 80
25	— 35, 5	22	— 0, 84
Oct. 17	— 52, 1		

Although a thermometer was attached to the clock, I could not from a necessary attendance to business register it regularly; the difference of its height in March and June may be taken at about 22 degrees, and in July and October 14, without much error.

On comparing it with the rate of the clock, the compensation, in the latter case, appears nearly as much too great, as it was in the first too small. The true length of the zinc rod ought to be about 23 inches.

The length of the zinc rod, thus ascertained, is $1\frac{3}{4}$ inch more than the experiment by the lamp makes it; indeed, I have always suspected there might be some error in that experiment, on account of the length of the arc of vibration being affected by it.

Having no means of finding the time accurately but by equal attitudes, I could not get so many observations as might be wished. I trust, however, these will not be found altogether useless.

I am, Sir,

Your obedient Servant,

HENRY WARD.

Blandford, Oct. 21, 1806.

To C. Taylor, M. D. Sec.

TEN GUINEAS *were this Session voted to Mr.* MARTIN FURNISS, *No.* 128, *Strand, for a new Air-tight Door Hinge.*

The following Communication was received from him, and an explanatory Engraving is annexed.

A Model of the Invention is placed in the Society's Repository.

SIR,

THE model I have herewith sent is my invention. I beg leave to lay it before the Society for the encouragement of Arts, Manufactures, and Commerce, in the hope that they will be pleased to examine it, and find it worthy of some mark of their approbation. It is a model for putting together the joints of a folding screen, so as to fold in either direction without admitting the smallest quantity of air; it may likewise be appropriated to hanging of doors.

I am, Sir,

Your humble Servant,

M. FURNISS.

No. 128. *Strand, London, Oct.* 15, 1806.

To C. TAYLOR, M. D. SEC.

A Certificate from Messrs. WILSONS, cabinet-makers in the Strand, testified that Mr. M. Furniss's model for screens or doors, is his own entire invention, and has been executed by them on a high-folding screen for a lady in Baker-street, Portman-square.

Reference

Reference to the Engraving of Mr. Furniss's Air-tight Hinge for a Door or Screen.

Fig. 9. A plan of the joint: A B, two sides of the screens with circular ends, joined by a piece of leather reaching from top to bottom fastened at C, and wrapping (like the letter s) partly round the curve of one fold of the screen, and partly round the other to D, where it is also fastened: E F, a chain formed of brass plates rivetted together, winding round in a groove from off one fold of the screen on to the other, the contrary way to the leather, and thus mutually keep each other stretched tight, the chain winding on when the leather winds off, and vice versa; thus they move smoothly round one another. G Fig. 10, a piece of brass (left out in the last figure in order to shew the chain) screwed to the centre of each curve of the screens which forms the hinge, and by keeping the folds of the screen at their proper distance secures the easy action of the chains and leather, and prevents their being over-stretched. H H, a line of green twist fastened along the bottom of the screens, and passing through a staple on the joint at G, serving to keep the screen air-tight on the floor.

Fig. 11 is an elevation shewing the top and bottom joints, with the same letters of reference.

The GOLD MEDAL *of the Society was this Session voted to Mr.* F. C. DANIEL, *of Wapping, for his Apparatus to secure Persons from sinking in Water, or to act as a Life Preserver when Shipwrecked.*

The following Communication was received from him, and an explanatory Engraving is annexed.

One of the Machines is preserved in the Society's Repository for public Inspection.

SIR,

I HAVE taken the liberty of sending one of my Life Preservers, and am proud to say, they have realized the name; and I shall feel myself obliged if you will cause it to be brought before the Society for their approbation. I beg to say, Sir, though I have given it publicity, it has never been before any committee.

I have inclosed a copy of a letter, which I received from the only surviving officer of the Alert private ship of war, and, independent of that document, I have had information from respectable authority, that the machines have saved several lives.

It is not, Sir, a pecuniary reward I look for, although I have sunk near 1500l. in the undertaking; yet, I must confess, to have the sanction of the Society of Arts would be highly flattering, and the world from that moment must be convinced of their utility.

I have the honour to be, Sir,

Your obedient Servant,

F. C. DANIEL.

Wapping, Oct. 22, 1806.

To C. TAYLOR, M. D. SEC.

Copy

Copy of a Letter from Mr. GEORGE WILLERS, *late Surgeon of the Alert, Private Ship of War, lost off the Western Islands.*

SIR,

I AM happy in having it in my power to say, I owe my life to your invaluable invention, the LIFE PRESERVER; and the circumstances relative thereto, are as follow :—I shipped as surgeon on board the Alert, private ship of war, mounting 18 guns, and 98 men, commanded by James Desormeaux, esq. belonging to Messrs. Wright and Birch, Walbrook. We sailed for Falmouth, April 1805, and, after cruising five months, on the 22d of September, we unfortunately struck on a rock in the Western Islands, and the ship went to pieces in five minutes ; at that time we had eighty-four men on board : I witnessed the loss of every officer, six in number, and sixty-four foremast men ; thirteen of the crew were saved, by clinging to pieces of the wreck, spars, &c. which drifted from the wreck ; and I have the happiness to say, by possessing one of your Life Preservers (though I cannot swim,) I was supported for some time, the sea running mountains high, but providentially a large Portuguese boat put off to my assistance, being then near a mile from the shore ; and I was thus saved by the hands of Providence, and your invention, from a watery grave.

I beg, Sir, you will permit me to acknowledge how much I feel myself obliged to you ; and you are at full liberty to make this case known for the benefit of mankind.

I am, Sir,
Your most obedient Servant,
G. H. WILLERS.

Kennington, Aug. 2, 1806

To F. C. DANIEL, Esq. Wapping,
Inventor of the Life Preserver when Shipwrecked.

SIR,

MR. George Willers, late surgeon of the Alert, private ship of war, and whom I succeeded as a surgeon in Mansion House-row, Kennington, in April 1807, went, as I have been informed, again to sea some time in the month of July or August following.

I have in my possession an engagement wrote by Mr. Willers, and which I have compared with the letter sent to Mr. Daniel, of Wapping, by him, giving an account of his happy escape from drowning, by means of his Life Preserver; and I have no hesitation in saying, that the letter is in Mr. Willer's hand-writing, so far as comparison will guide me, having seen him *write* and *sign* the engagement above mentioned.

I have the honour to be, &c. &c.

HUGH BROWN.

Mansion House-row, Kennington, March 7, 1808.

To C. TAYLOR, M. D. SEC.

Copy of a Letter from JOHN DICKENSON, *Esq. of the City of Norwich, to Mr.* DANIEL.

SIR,

I INTENDED myself the pleasure of calling on you, and acquainting you personally of a singular incident, when the

the excellence of your machine, or Life Preserver, was most conspicuously manifested.

I went from the city of Norwich, in a pleasure-boat that I keep for the amusement of sailing, in company with a gentleman and two ladies. As our return to Norwich, in the evening, was indispensible, and the direction of the wind favouring us both ways, a few hours would effect it, the distance being only thirty miles: accordingly we set sail about four o'clock, it being moon-light during the night; and fortunately procured, in case of accident (the wind blowing hard at south-east) one of your Life Preservers, through the interest of a friend, of a captain, who had purchased one at Newcastle. The precaution proved, in a short time after sailing, to have been a fortunate one indeed. On tacking to enter Norwich river, at the extremity of a broad water, two miles over, known by the name of Braydon, a sudden gust overset the boat, precipitating myself, companion, and two ladies, into as agitated a water as I have ever seen at sea, (except in hard blowing weather). You may judge my situation at such a juncture. Your machine was jokingly filled as we came along, to which I ascribe (though very unexpected by us) our preservation. The gentleman, whose name is Goring, was inexpert at swimming, and with difficulty kept himself up, till I reached him; and then directing him to lay hold of the collar of my coat, over which the machine was fixed, I proceeded towards the ladies, whose clothes kept them buoyant, but in a state of fainting when I reached them: then taking one of the ladies under each arm, with Mr. Goring hanging from the collar of the coat, the violence of the wind drifted us on shore upon Burgh Marshes, where the boat had already been thrown, with what belonged to her. We got the assist-

anceof some country men directly, (after taking refreshment at a marsh farmer's house, where we procured some dry clothing for the ladies, who were now pretty well recovered,) and by their endeavours put the boat in sailing trim, and prosecuted our voyage to Norwich, which we effected by eleven o'clock that night.

From this singular escape, on my return from Birmingham, I shall be induced to inspect your warehouse, and procure the various prices of your invention, anxious to recommend it in even sailing excursions, in which its utility has been so evidently demonstrated, and its use ascertained.

You are at liberty, Sir, to make whatever use you please of this account, and I beg to subscribe myself,

Sir,

Your most obedient humble Servant,

JOHN DICKENSON.

Swan with Two-Necks, Lad-lane,
Jan. 30, 1807.

SIR,

I HAVE lately received a letter from my friend, Mr. A. French, making enquiry respecting an accident which happened some time since, at the extremity of an extensive piece of water, (called Braydon, near this town) of a pleasure-boat being upset, in which were two ladies and two gentlemen, who were providentially saved by one of Daniel's

Life

Life Preserver's, from the turbulence of an open water, which, when the wind is high, is very violent, and resembles a rough sea. I beg leave, therefore, to acquaint you, Sir, for the information of the Society of Arts, &c. that the above circumstance is within the recollection of myself and many other persons in this place, and also of Norwich, to which city the boat was destined. I feel myself happy in giving this testimony of the excellence of the Life Preserver; and for humanity's sake, I sincerely hope its publicity will be promoted as much as possible, and patronized by every enlightened individual.

I am, Sir,

Your obedient Servant,

W. BARTH.

Great Yarmouth, March 7, 1808.

To C. TAYLOR, M. D. SEC.

Reference to Mr. Daniel's Machine, called a Life Preserver when Shipwrecked, Pl. 10. *Fig.* 1.

A, represents the body of the machine, which is double throughout, made of pliable water-proof leather, large enough to admit its encircling the body of the wearer, whose head is to pass betwixt the two fixed straps, B B, which rest upon the shoulders; the arms of the wearer pass through the spaces on the outside of the straps; one on each side, admitting the machine under them to encircle the body like a large hollow belt; the strap, C, on the lower part of the machine, is attached to the back of it, and

by passing betwixt the thighs of the wearer, and buckling at D, holds the machine sufficiently firm to the body, without too much pressure under the arms. The machine being thus fixed, is inflated with air by the wearer blowing in from his lungs through the cock, E, a sufficient quantity of air to fill the machine, which air is retained by turning the stop-cock. The machine, when filled with air, will displace a sufficient quantity of water to prevent four persons from sinking under water.

Mr. Daniel recommends his Life Preservers to be prepared as follows: viz. To select sound German horse-hides, and to cut a piece six feet long, and two feet six inches wide, free from blemish or shell; it is first to be curried, and then rendered water-proof by Mollersteins patent varnish, of Osborn-street, Whitechapel, which preserves the leather more supple, and admits it to be easier inflated than any other water-proof leather.

The leather is nailed on a board, and the varnish applied upon it; it is then to be passed into an oven several times, the varnish being each time repeated, till the leather is completely covered; it is then cut in the form of a jacket, as above described, and neatly and firmly stitched; the seams and stitches are afterwards to be perfectly secured by the following black elastic varnish.

℞.—Gum asphaltum, two pounds; amber, half a pound; gum benzoin, six ounces; linseed-oil, two pounds; spirits of turpentine, eight pounds; and lamp-black, half a pound; united together in an earthern vessel with a gentle heat. The machine, when properly made according to the drawing and description, resembles a broad belt, or circular girdle, composed of two folds of pliable leather attached together, and perfectly impervious to water. When used, the wearer

wearer introduces his head and arms within the circle, the stop-cock in front, the two fixed straps, E E, rest one upon each shoulder, to prevent the belt from sinking down; the lower strap, C, is then brought between the thighs, and buckled in front, which prevents the machine from being forced back; the machine is then inflated by the application of the mouth to the stop-cock in front, and when properly filled, the turning of the cock retains the air in the machine, and expands it so much as to displace a quantity of water so great, as to sustain the wearer, and a further weight, if necessary, buoyant in the water.

A Publicity having been recently given to some Experiments off the Eastern Coasts of this Island, for preserving Lives in Cases of Shipwrech, by Means of a Rope attached to a Shell thrown from a Mortar; the Society think it incumbent on them to remind the Public, that so far back as the year 1792, *a Bounty of Fifty Guineas was given to Mr.* JOHN BELL, *then Serjeant, afterwards Lieutenant of the Royal Regiment of Artillery, for his Invention of throwing a Rope on Shore, by means of a Shell from a Mortar, on board the Vessel in distress; the particulars of which were published in the tenth volume of the Society's Transactions, page* 204; *but a descriptive Engraving having been omitted at that time, it is thought expedient to insert it in the pre-*

sent Publication, with some further Particulars then omitted.

Models and Drawings of the whole Apparatus are reserved in the Society's Repository, for the Inspection of the Public.

THE several trials made before a Committee of the Society at Woolwich, on the 29th of August 1791, of throwing a line on shore on this principle, were as follow.

From a boat moored about 250 yards from shore, the shell was thrown 150 yards on shore, with the rope attached to it; the shell was of cast-iron, filled with lead, it weighed 75 pounds, its diameter eight inches; the rope in the trial was a deep sea-line, of which 160 yards weighed 18 lbs. the angle of the mortar from whence the shell was fired, was 45 degrees. By means of the line, Mr. Bell and another man worked themselves on shore upon his raft of casks; there were many kinks in the rope, which were with ease cleared by Mr. Bell, in which he was much assisted by his snatch blocks.

The second trial was repeated in a similar manner, and with equal success, the shell falling within a few yards of the former place, the gale of wind was brisk, and the water rough. The direction of the shell was nearly from north to south, and the wind blew nearly north-west.

In the third trial, the mortar was elevated to 70 degrees; the rope attached to the shell, was an inch and half tarred rope, of which every 50 yards weighed fourteen pounds and a half; the shell of the kind above-mentioned, it fell 160 yards from the mortar, and buried itself about two thirds in the ground; the line or rope ran out was about 200 yards, and it required

quired the force of three men to draw the shell out of the ground at that distance.

The grommet, in all these trials, was of white three inch rope; and in all the above trials, by means of the line, two men worked themselves on shore upon the raft: each charge of powder was fifteen ounces.

A fourth experiment was made by firing, from the same mortar, a grapnel in a wooden case; it did not retain its hold in the ground so well as the shell, but amongst the crevices of rocks, or where the vessel is near shore, will be useful.

A grapnel of this kind may be fired from a common cannon with an endless rope, running in a pulley or small block fixed thereto, by which a raft may be successively drawn to and from the vessel either by the persons on board the vessel, or those on shore.

Observations made by Lieutenant Bell, upon throwing a Line on Shore in Case of a Ship being stranded.

1st, From the proposed construction of the piece of ordnance, intended to throw the shot and line on shore, I suppose it will be between five and six hundred weight.

The chamber is to contain one pound of powder, and the bore to admit a leaden ball of sixty pounds or upwards; the length of range, or distance, will depend upon the size of the line made use of; I suppose it will carry a deep sea-line between three and four hundred yards distance.

2d. All ships that have iron ballast, may use this piece

as

as a part of it, and then there would be only the trifling difference of casting so much of the ballast into the form of the piece; the leaden balls may likewise be used as ballast.

3d. I am of opinion there are various ways, on board of a ship, that the mortar may be placed in a proper position for firing without a carriage expressly made for it; it may be placed upon a coil of rope, or its trunnions rested upon coins, or any thing else, whereby the muzzle can be raised so high that the groove upon the trunnion appears vertical, as the piece in that position would be elevated nearly 45 degrees.

4th. As I imagine all ships carry deep sea-lines, on that account I made use of it in the experiments at Woolwich, but if it should be thought too short for the distance, any other light line may be added to the length of it.

5th. Supposing a ship's owner to purchase such a piece of ordnance with the leaden balls, and a block carriage; I do not think the whole would amount to more than ten or eleven pounds expence.

6th. Where a ship is driving or unmanageable near the shore, it would be proper to have the piece loaded, the line reeled upon hand-spikes or poles, and laid upon the deck ready for firing at any time it might be judged necessary. The hand-spikes or poles, the line is reeled upon, preserve it in an horizontal form; and they are not to be drawn out until the instant of firing: in this manner the line will deliver itself freely.

The five water-casks should also be prepared in readiness, by lashing them together, and a seaman's chest fixed upon the top of them, having part of its ends or sides cut out in order to let out such water as may be thrown into it by the surf. I dare undertake to land with such a float upon a lee

a lee shore any where upon the coast, when it might be deemed unsafe for a boat to make good its landing.

7th. There is every reason to conclude, that this contrivance would be very useful at all ports of difficult access both at home and abroad, where ships are liable to strike ground before they enter the harbour, as Shields Bar, and other similar situations, when a line might be thrown over the ship, which might probably be the means of saving both lives and property; and moreover, if a ship, was driven on shore near such a place, the apparatus might easily be removed to afford assistance; and the whole performance is so exceedingly simple, that any person once seeing it done, would not want any further instructions.

JOHN BELL.

Woolwich, Aug. 29, 1791.

Some further Observations made by Lieutenant Bell, upon the Application of the Mortars intended for throwing a Line on Shore, in Case of a Ship being stranded.

1st. In trading ships, this piece would answer for making signals of distress, by filling the chamber with powder, and well wadding it, as the report would be heard some miles distance at sea.

2d. Such a gun, being accompanied with a few rounds of round and grape shot, would defend a ship much better than

than a longer gun, against any piratical or other hostile intentions, as, from its shortness, it would be more readily loaded and fired with a larger charge each time.

3rd. Accidents from a gun bursting, which may arise from an unskilful person loading with too great a proportion of powder, is in this piece effectually guarded against, by the chamber being constructed to contain but one pound of powder, a quantity which is only about one-third of the usual charge of a cannon.

4th. From the small size of such a gun and carriage, it might be kept upon deck, without much inconvenience in working the ship, in order to be ready if necessity required; and when the ship is out at sea, it might then be put below. But from the number of dreadful wrecks, which so frequently happen along the coast, it certainly would be prudent to have it always upon deck when within sight of land, and particularly in stormy weather.

JOHN BELL.

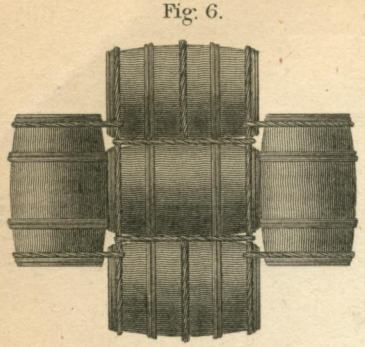
Woolwich, Sept. 30, 1791.

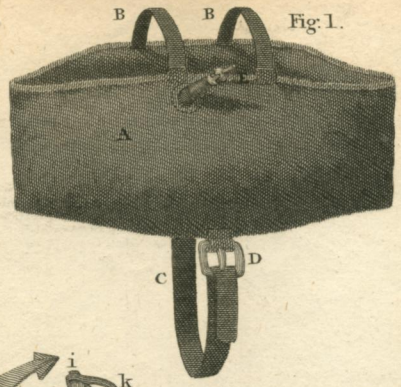
To C. TAYLOR, M. D. SEC.

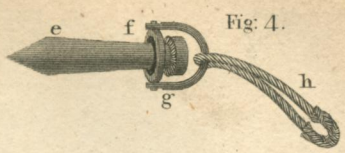
Reference to the Engraving of Lieutenant Bell's Method of throwing a Rope on Shore, from a stranded Vessel, Pl. 10. Fig. 2.

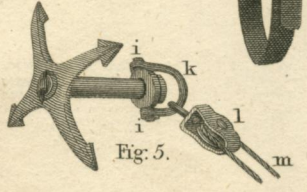
a, Represents the mortar on its carriage; *b*, the shell shown within the mortar by dotted lines; *c*, the grommet, or double rope, which connects the shell and line; *d d*, the line

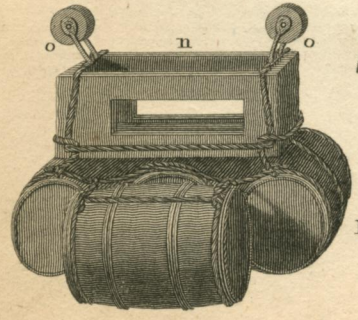
Mr. Daniel's Life-preserver from Shipwreck.

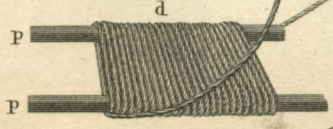












Lieut.t Bell's Method of saving persons from stranded Ships.

C. Varley del.
S. Porter sculp.

line to be thrown on shore, now ready wound on the poles or hand-spikes, *p p*, and which are to be withdrawn when the mortar is fired.

Fig. 3. Is a separate view of the shell, with the grommet and end of the line attached thereto, explained by the same letters.

Fig. 4. Shows another invention, suggested instead of a shell, and to be fired from a common cannon, in which *e*, is an iron pin; *f*, an iron collar and rope sliding upon it; *g*, an iron ring which turns upon two pins in the collar; *h*, is the grommet or double rope, attached to the ring, to which the line to be thrown on shore is fastened. This plan may be used where people are on shore, to assist when a line is thrown.

Fig. 5. Shows a grapnel which may also be fired from a common cannon; the collar slides along it in the same manner as that in fig. 4, to allow the head of the pin to go down to the wadding within the cannon; *i i*, are two pins on which the ring *k*, is moveable; *l*, the block or pulley fastened to the ring; *m*, the endless or double line running through it.

This method may be used with great advantage, where a ship is stranded near the shore; but where a mortar is on board, the use of the shell and line is the most certain.

Fig. 6. Shows the method of forming a raft, by lashing together with ropes five empty water-casks belonging to the ship.

Fig. 7. Represents the raft ready for use; the apparatus *n* to hold the person upon it, is made from a seaman's chest with holes cut in the sides of it, to allow the person within it firmer hold, and to let out the water that may be thrown into it from the waves; *o o* are two pulleys attached to the ends of the chest,

chest, and through which the line is to run; the raft is to be ballasted underneath, to prevent it from upsetting.

The whole apparatus is so arranged as to be inclosed in a small box, as may be seen by a reference to that in the Society's possession.

PAPERS